

THE MORPHOLOGY OF NANNOCHORISTA MACULIPENNIS TILLYARD (MECOPTERA)

By J. W. EVANS

[Read 8 October 1942]

The Mecoptera, which at the present day comprise one of the smallest orders of insects, are of great interest to students of insect morphology because it is generally accepted that they lie at the base of the evolutionary stem from which have arisen all the holometabolous orders, including the Coleoptera. The order is divided into two sub-orders, the Protomecoptera and the Eumecoptera. One family of the Protomecoptera, the Meropeidae, is represented in the Australian region and four out of the five families of the Eumecoptera occur here. Three of these have a world-wide distribution, whilst one family, the Nannochoristidae, has only been recorded from Australia, Tasmania, New Zealand and Southern Chile.

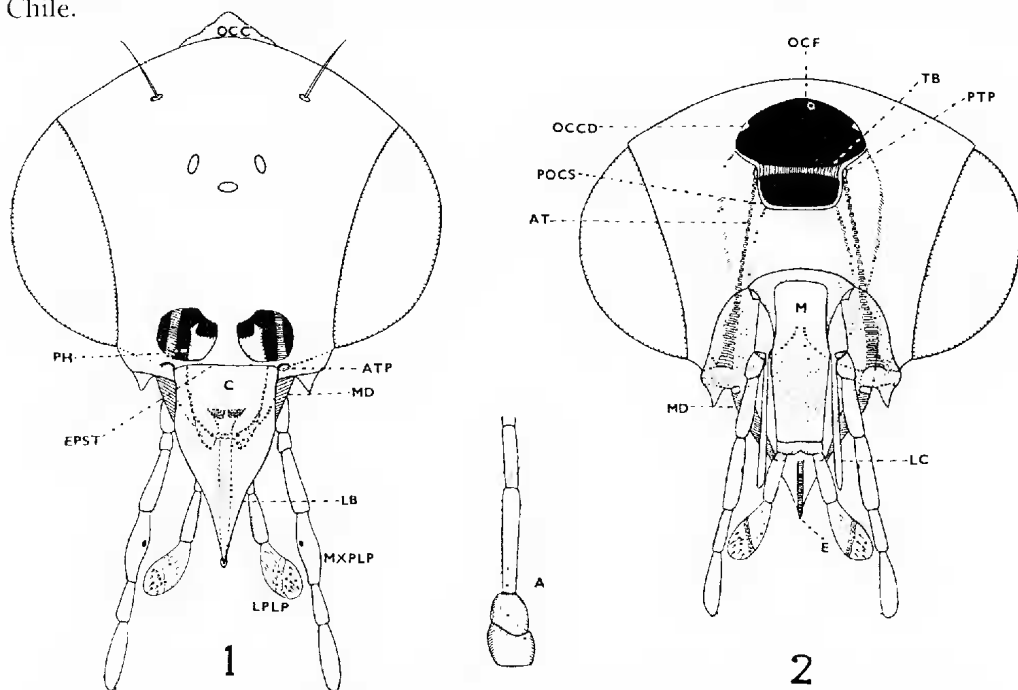


Fig. 1 *Nannochorista maculipennis*—Head in dorsal aspect: A, antenna; ATP, anterior tentorial pit; C, clypeus; EPST, epistomal suture; LB, labrum; LPLP, labial palp; MD, mandible; MXPLP, maxillary palp; OCC, occiput; PH, pharynx. Fig. 2 Head in ventral aspect: AT, anterior arm of tentorium; E, epipharynx; LC, lacinia; M, mentum; OCCD, occipital condyle; OCF, occipital foramen; POCS, postoccipital suture; PTP, posterior tentorial pit; TB, tentorial bar.

The present study, which has been undertaken in order to make better known an archaic though specialised type, has been made possible by the collection of a large number of specimens of *Nannochorista maculipennis* Tillyard. This species, one of the four species of *Nannochorista* so far recorded from Tasmania, was originally described from a single male specimen collected on Cradle Mountain, Tasmania, at a height of 3,500 feet. During February 1941, countless represen-

tatives of *N. maculipennis* were found flying around shrubs, especially *Orites acicularis*, growing at a height of 3,800 feet on Mount Wellington, near Hobart, Tasmania.

Tillyard (1917) thought that the larvae of *Nannochorista* were almost certainly aquatic. This is improbable, and although small pools and streams abound in the shallow, swampy valley where most of the insects were taken, several were also found at a considerable distance from any exposed water surface. It is believed that the larvae inhabit damp moss and that a Mecopterous larva described recently (Evans, 1942) may well be the larva of a species of *Nannochorista*.

DESCRIPTION

N. maculipennis is a small fragile insect with a wing expanse of about 14 mm. The body is brown in colour and the wings hyaline with brown markings.

The Head (Fig. 1-4)

The head is small and globular, the eyes large and three ocelli are present. The antennae consist of twenty-four segments, the two proximal ones being broader and shorter than the rest. Little trace remains of the various cranial

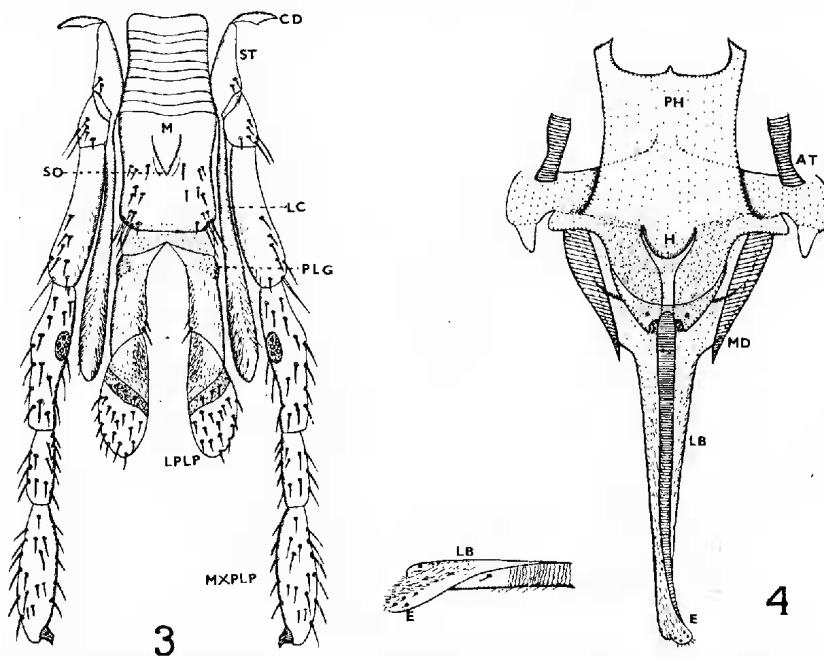


Fig. 3 *Nannochorista maculipennis*—Labium and maxillae: CD, cardo; PLG, palpiger; SO, salivary orifice; ST, stipes. Fig. 4 Anterior part of head of same, viewed internally: H, hypopharynx; other lettering as in previous figures.

sutures. An occipital suture separates off a small triangular occiput and continues ventrally around the occipital foramen, and the epistomal suture lies just anterior to the antennae between the pits of the anterior arms of the tentorium. Indistinct subgenal sutures extend laterally from these pits as far as the eyes on each side. The mandibles are reduced and probably functionless since the adductor and abductor muscle apodemes are suppressed. Each maxilla consists of a small recurved cardo and a narrow stipes from which arises a single process, probably the lacinia.

The maxillary palps are five-segmented; sense organs occur on the third and apical segments. The labium comprises a long, narrow sclerite in contact with the stipes of the maxilla on each side and a pair of palps. The prementum is reduced to a narrow membranous band and a pair of palpigers. The palps, which are convex on their external surfaces and concave internally, have grooves on their inner surfaces lined with forwardly-projecting hairs. The apical segment of each palp, which is larger than the proximal segment, is armed with short strong spines. In life, the palps are not widely separated, as shown in the figures, but are held out in front in contact with each other, below the apposed laciniae. The single plate of the postmentum is believed to represent the mentum; a submentum is not developed. The area between the labium and the occipital foramen consists of a hypostomal bridge and not a gula.

The labrum is long and narrow and together with the epipharynx forms an apically-swollen tongue-like structure. The pharynx is sclerotised anteriorly and trough-shaped. The dorsal surface of the trough, to which are attached dilator muscles that arise on the clypeus, is of thicker consistency than the ventral surface. The hypopharynx arises from the ventral surface of the trough and is a flattened rounded lobe.

The Thorax (Fig. 5, 6, 8, 9)

In the description of the thorax which follows, Ferris' (1939) interpretation of thoracic structure is adopted.

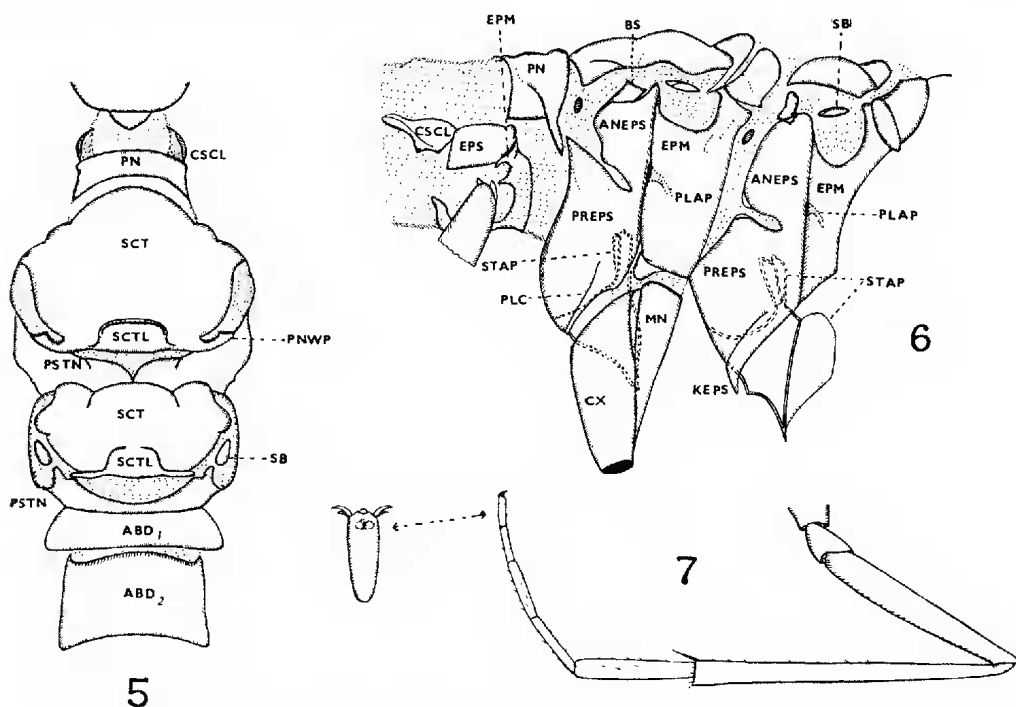


Fig. 5 *Nannochorista maculipennis*—Thorax in dorsal aspect: ABD, abdominal segment; CSCL, cervical sclerite; PN, pronotum; PNWP, posterior notal wing process; PSTN, postnotum; SB, subalar sclerite; SCT, scutum. Fig. 6 Thorax of same in lateral aspect: ANEPS, anepisternum; BS, basalar sclerite; CX, coxa; EPM, epimeron; EPS, episternum; KEPS, kataposternum; MN, meron; PLAP, pleural apodeme; PREPS, preepisternum; PLC, pleural costa; STAP, sternal apophysis. Fig. 7 Hind-leg of same.

The prothorax has a well-developed notum, a small episternum and a reduced epimeron. A pair of apophyses which arise from pits on the prosternum extend to and are attached to the epimeron. The mesothorax and metathorax so closely resemble each other that separate description is unnecessary. Each is divided dorsally into a large scutum, a small scutellum and a narrow postnotum. Laterally, the episternum is partially divided into three distinct areas comprising a dorsal anepisternum, a median preepisternum and a narrow ventral katepisternum. The preepisterna and katepisterna of the two sides are infolded mid-ventrally at the discriminial line and a pair of large apophyses, fused medially but free proximally and distally, arise from the apposed katepisterna. These apophyses represent all that remains of a true sternum. The epimera are undivided, a coxal meron is developed and no trace remains of a trochantin.

The forewings and hindwings resemble each other in size, shape and venation. Each forewing has a single jugal bristle and each hindwing three frenalur bristles. The legs are long and have five tarsal segments of which the proximal segment is considerably the largest. There are two pairs of thoracic spiracles situated as shown in fig. 6, and eight pairs of abdominal spiracles.

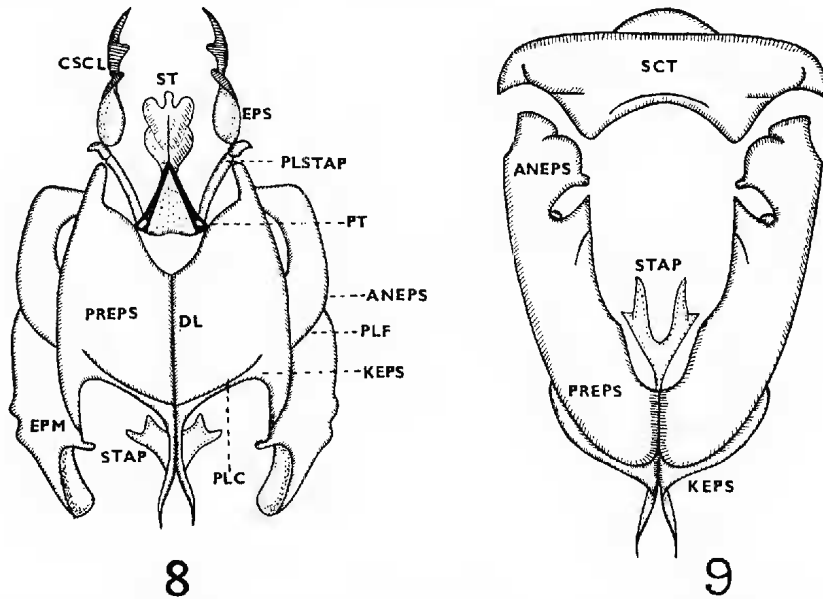


Fig. 8 *Nannochorista maculipennis*—Prothorax and mesothorax, ventral aspect: DL, discriminial line; PLF, pleural fold; PLSTAP, pleuro-sternal apophysis; other lettering as in fig. 5 and 6. Fig. 9 Mesothorax of same, anterior aspect—Lettering as in previous figures.

The Abdomen

♂ (fig. 12)—The apical abdominal segments of the male consist of a well-developed seventh segment divided into a tergite and sternite, a reduced eighth segment consisting of a complete ring, and a still more reduced ninth segment, also a complete ring. A pair of ventrally-fused bulbous coxopodites arise from the ninth segment, to which are attached a pair of inwardly-toothed harpogones or styles. The phallus, which comprises a median aedeagus covered by a hood-shaped structure, and a pair of ventral lobes, is sunk within the cavity of the coxopodites. The tenth segment is a small complete ring and bears a pair of one-segmented cerci which lie on either side of the eleventh or anal segment. The anal segment consists of distinct dorsal and ventral plates.

♀ (fig. 11)—The female genitalia are of a simple type. The eighth segment bears a pair of ventral lobes which partially overlap the ninth segment; a pair of small laterotergites occur on either side of these lobes. The sternite of

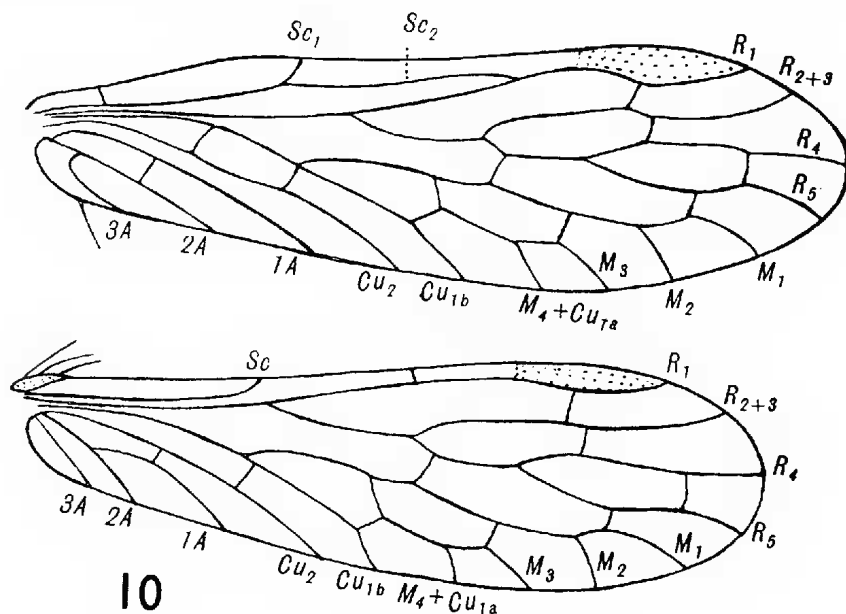


Fig. 10 *Nannochorista maculipennis*—Fore and hind-wings

the ninth segment is divided into two narrow processes. The tenth segment consists of a complete ring, and the anal segment which lies between the cercal bases, as in the male, consists of separate dorsal and ventral sclerites. The cerci are well developed and two-segmented.

COMPARISON WITH OTHER MECOPTERA

The head of *Nannochorista* differs from those of *Panorpodes*, *Panorpa*, *Boreus*, *Bittacus*, *Apterobittacus* and *Merope* as figured by Otanes (1922) and from the heads of *Apteropanorpa* and *Harpobittacus* in size, being considerably smaller, in shape, being globular, not elongated, and in certain structural features. Species in the genera mentioned above are carnivorous insects with well-developed mandibles. *Nannochorista* feeds by suction or rather "sipping." In most Mecoptera the clypeus and labrum are distinct, the former often being as much as four or five times the length of the latter. In *Nannochorista* the labrum is longer than the clypeus and no external sutures serve to indicate the limits of the two sclerites. The elongation of the head in other genera has resulted in the arching of the subgenal sutures; in *Nannochorista* the subgenal sutures are more or less in a line with the epistomal suture and close to the base of the mandibles. It is uncertain whether the mandibles are entirely functionless, but at the most they can only serve to form part of the walls of a sucking tube. In other Mecoptera the mandibles are elongated and toothed and equipped with strong muscle apodemes.

In having a single process instead of two, the maxilla differs from that of related genera. Otanes considered the divided process of the Mecopterous maxilla represented a divided galea, Ferris and Rees a galea and a lacinia, or at least a

divided lacinia. As the only type examined which displays any tendency to a reduction of either lobe is *Apteropanorpa*, in which the outer lobe is very small and weak, and the inner lobe resembles in shape and appearance the process of *Nannochorista*, the latter is assumed to be the lacinia.

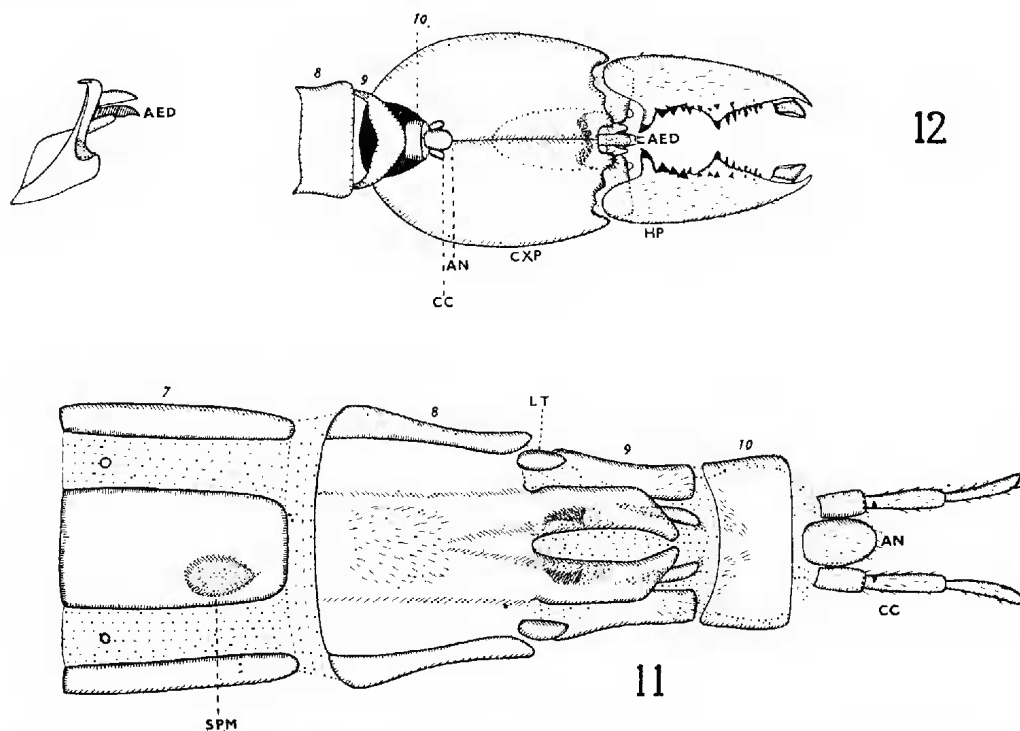


Fig. 11 *Nannochorista maculipennis*—Apical abdominal segments of female: AN, anal segment; CC, cercus; LT, laterotergite; SPM, spermatheca. Fig. 12 Male terminal segments—AED, aedeagus; CXP, coxopodite; HP, harpogone; other lettering as in fig 11.

In most Mecoptera the labium consists of a small wide basal sclerite, the mentum, followed anteriorly by a narrow partially-divided plate, the prementum, also a pair of two-segmented palps of which the proximal segments are larger than the distal ones. Such a condition is found in *Apteropanorpa tasmanica* and is well illustrated for *Panorpa nuptialis* by Ferris and Rees. In these species there is also a large submental area overlying a pair of labial apodemes that arises from the base of the prementum. In *Nannochorista* the prementum is represented only by a narrow membranous area and a pair of palpigers. Tillyard originally (1917) considered the labial palps to be paraglossae, later (1926), he recognised their true identity. The sclerotisation of the dorsal wall of the pharynx anteriorly, in conjunction with the development of a sucking pump, is more marked in *Nannochorista* than in other Mecoptera, though it is probable that such a development occurs to some extent in all representatives of the order.

The tentorium is of the normal type for the group though in *Apteropanorpa* the pits of the posterior arms are situated at the ventral corners of the occipital foramen and not midway along the sides. It is almost certain that the elongation of the clypeus and the consequent wide separation of the mouth-parts from the head-capsule, such as occurs almost universally in the Mecoptera, is a secondary development from the condition retained in *Nannochorista*. Nevertheless, although

the head of *Nannochorista* can be considered primitive in this respect, in other characteristics it is extremely specialised.

The thorax of *Nannochorista* closely resembles those of *Panorpa nuptialis* figured by Ferris and Rees, and of *P. consuetudinis* illustrated in Snodgrass (1937, fig. 99). The only significant difference lies in the development of a pleural cleft in the mesothorax which separates the anepisternum from the preepisternum almost as completely as in the Neuroptera. The retention of jugal and frenal bristles on the wings, which are suppressed in most families, is a characteristic the Nannochoristidae shares only with the Choristidae. So far as the venation is concerned, the only unusual feature is the partial fusion of the media and the first cubitus.

Tillyard (1935) recognised three types of genitalia, the very reduced Meropid type; the Bittacid, which he considered the most primitive existing type, and the Panorpid or bulbous type. The male genitalia of *Nannochorista* belong to the bulbous type but differ from others in this group in the structure of the ninth abdominal segment, the tergite and sternite of which do not partially conceal the coxopodites. The female genitalia are more complete and less specialised than those of certain other Mecoptera, as they retain a pair of gonapophyses on the eighth abdominal segment and have separate cercal bases.

COMPARISON WITH THE DIPTERA

It has been claimed (Tillyard, 1937) that the nearest approach among the Mecoptera to the type of Dipterous head-capsule and mouth-parts is to be found in the Nannochoristidae. Further, that the archaic Blepharocerid *Edwardsina* Alex., which like *Nannochorista* has an Antarctic distribution, is the representative of present-day Diptera most nearly related to *Nannochorista*.

An investigation of the head-structure of *Edwardsina tasmaniensis* Tonnoir (fig. 13-15) discloses that there are only two cephalic characteristics shared by *Nannochorista* and *Edwardsina* which are not also possessed by other Mecoptera.

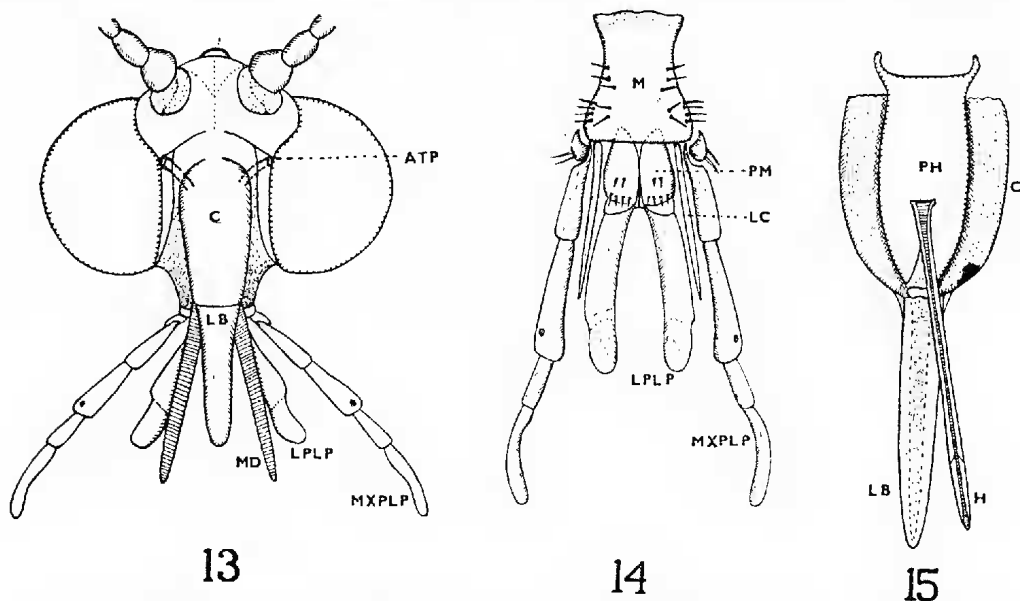


Fig. 13-15 *Edwardsina tasmaniensis* (♀): 13, head; 14, labium and maxillae, PM, prementum; 15, anterior part of head, viewed internally. Lettering as in previous figures.

These are the single maxillary lobe and the presence of a sense-organ on the third segment of the maxillary palps. Among the characters which *Edwardsina* has in common with the majority of Mecopterous genera are a sclerotised pharynx, a postmentum consisting of a single plate, the mentum, two-segmented labial palps, the suppression of glossae and paraglossae and narrow elongated mandibles. The prementum of *Edwardsina* resembles that of all Mecoptera except *Nannochorista*.

The head of *Edwardsina* differs from that of Mecoptera in the position of the clypeus and in the great elongation of the hypopharynx. It is probable that these characteristics are related to each other, as it is evident from the arching of the subgnathal and epistomal sutures in *Edwardsina* that the clypeal position is a secondary development. This development may have resulted from the increased pull of the dilator muscles of the sucking pump on the inner surface of the clypeus which followed the change in the function of the mouth-parts that accompanied the elongation of the hypopharynx.

Several Diptera possess a single maxillary lobe, and if Rees and Ferris (1939) are correct in regarding this lobe in Tipulids as the lacinia, and Snodgrass correct in regarding the maxillary process of Tabanids as the galea, then the Diptera must have arisen from a Mecopterous type possessing both a lacinia and a galea. A comparison of the head of *Tipula reesi* as figured by Rees and Ferris with the head of *Panorpa nuptialis* figured by Ferris and Rees, discloses that these two insects resemble each other more closely than do *Edwardsina* and *Nannochorista*. Both have a long narrow clypeus which lies anterior to the eyes and a distinct labrum, also the hypopharynx of *T. reesi* is suppressed, not enlarged as in *Edwardsina*. It is therefore suggested that *Nannochorista* is not so closely related to the Diptera as the other Mecoptera which have an elongate head.

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TREMATODES FROM AUSTRALIAN BIRDS

I CORMORANTS AND DARTERS

By T. HARVEY JOHNSTON, University of Adelaide

Summary

The earliest record of the presence of trematodes in Australian birds was by Krefft (1873), who reported *Distomum* spp. from two species of herons and from a coot from Eastern Australia. The first paper describing flukes from our birds was that published by S. J. Johnston (1904) giving an account of three species of *Holostomum* (from a gull, tern and heron, respectively) and two of *Hemistomum* (from a black swan and *Dacelo*, respectively), all of these having been obtained in New South Wales. T. H. Johnston (1910; 1912) referred to various bird parasites under broad generic terms, e.g., *Echinostomum* and *Monostomum*. S. J. Johnston followed on (1913) with an account of two new species from North Queensland and a record of two already known species. In the following year Nicoll (1914 a; 1914 b) published two papers dealing with parasites from Northern Queensland birds, the first describing seven new species and recording one already known elsewhere, the second paper including eleven new species and four previously known elsewhere. In 1916 T. H. Johnston issued his census of the endoparasites recorded from Queensland animals, including birds (1916).

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Next year S. J. Johnston published the most extensive paper that has yet appeared relating to flukes from Australian birds. It included the description of twenty-one species of trematodes and gave a list of recorded species (1917). The latter portion of this paper (p. 251-253) contains some errors and omissions which have been carried over into the work of later authors. He omitted to list *Notocotylus attenuatus* from *Anseranas sculpalmata*, *Burhinus grallarius* and *Lobivanellus lobatus*; *Opisthorchis obsequens* from *Hieracidea orientalis*; and *Patagifer bilobus* from *Carphibis spinicollis*, these records having been published by Nicoll (1914), all from North Queensland; also *Patagifer bilobus* recorded from *Ibis molucca* by T. H. Johnston (1916) from Southern Queensland. *Strigea flosculus*, reported by Nicoll (1914) from *Podargus strigoides*, was listed by Johnston (1917, 253) under *Dacelo gigas* and omitted from its proper host. *Hemistomum triangulare* (= *Adenodiplostomum triangulare*) whose true host is *Dacelo gigas*, was placed under *Ninox maculata* in addition. It might be mentioned that these errors relate to three host species which follow each other in S. J. Johnston's list, and may have been due to accidental transposition of the lines during typing. He also referred (p. 251) to *Hemistomum triangulare* "parasitic in *Dacelo gigas* and *Ninox maculata* in New South Wales." In reply to my query, Professor E. A. Briggs of the Zoology Department of the University of Sydney, a member of the late Professor S. J. Johnston's staff, informed me that he could not locate any specimens of trematodes from these two hosts amongst the collections belonging to that department. The hosts are not related and they have different food habits. The record of *Adenodiplostomum triangulare* from *Ninox maculata* and *Strigea flosculus* from *Dacelo gigas* (which latter record Dubois (1938) has listed, following S. J. Johnston) should be deleted until corroborated.

Next year T. H. Johnston (1918) identified specifically the various trematodes which he had previously (1910, 1912, 1916) indicated under broad generic names. In 1921 Miss Chase described a Strigeid from a heron. Next year

Cleland (1922) published a paper which contained, amongst other parasites, a list of trematodes recorded from Australian birds, but as this was stated to have been based on S. J. Johnston's paper (1917), it includes the same errors as the latter's work. It was not till 1928 that the next contribution relating to our subject appeared, when T. H. Johnston described three species from *Gallinula*.

Dubois in 1937 (1937 a, 1937 b) published papers in which were described some Strigeids from Australian birds, and in his excellent monograph of the Strigeata (1938) he dealt with all known Australian species (except one) of the group. He included one of S. J. Johnston's erroneous references (p. 71, 480) relating to *Strigea flosculus*, and wrongly listed *Cardiocephalus musculosus* (Johnston 1904) under the Caspian tern, *Hydroprogne caspia*, whereas its host was *Sterna bergii*, the crested tern (p. 116, 481). In passing, it may be mentioned that Dubois in his monograph omitted mention of *Tetracotyle tiliquae* Nicoll. This metacercaria was obtained from the lizard, *Tiliqua scincoides*, and its adult stage will probably be found in an Australian hawk.

Miss Young (1939) published a list of helminth parasites recorded from Australia. Internal evidence indicates that her recording did not take cognisance of work published after 1937, in fact several papers which appeared in that year were omitted. The list is not critical and frequently the same host appears in two different places, since little attempt seems to have been made to give cross references to synonymy of hosts or parasites. The following records of parasites have been omitted: *Catantropis gallinulae*, *Echinostoma australe* and *E. bancrofti* described by T. H. Johnston (1918) from *Gallinula tenebrosa*; *Opisthorchis obsequens* by Nicoll (1914) from *Hieracidea orientalis*; and *Patagifer bilobus* recorded by T. H. Johnston (1916) from *Ibis molucca*. *Echinostoma australianum* Nicoll is referred to as *E. australium* (p. 61).

In 1940 Miss Goss described two species from Western Australian cormorants. In the same year Johnston and Simpson gave an account of the life history of the bird trematodes, *Leucochloridium australiense* (1904 a) and *Cyclocoelum jaenschii* (1940 b). Next year Johnston and Angel described the life history of *Diplostomum murrayense* from terns (1941 a), *Petasiger australis* from grebes (1941 b), and *Echinostomum revolutum* from various Australian ducks and the black swan (1941 c). An account of the life history of *Paryphostomum tenuicollis* from cormorants was published recently (Johnston and Angel, 1942).

The only records of the presence of trematodes in domesticated birds in Australia are: (1) *Prosthogonimus oratus* (an error for *P. pellucidus*) by T. H. Johnston (1910, 116), based on a report by Spencer on the occurrence of trematodes in the egg of a domesticated fowl in Victoria (Proc. Roy. Soc. Vict., 1, 1888, 109); (2) *Echinostoma revolutum* from domestic ducks in Queensland by Roberts (1934, 5; 1939, 6). I now record *Echinoparyphium recurvatum* Linst. from a turkey in Melbourne (coll. Dr. A. W. Turner). The pigeon was proved to be capable of experimental infection with *Echinostoma revolutum* in Adelaide (Johnston and Angel, 1941 c).

I have been unable to trace the types and other material belonging to the avian species described by the late Professor S. J. Johnston in 1904. At that time he was economic zoologist to the Sydney Technological Museum. Mr. T. C. Roughley of that institution and Professor E. A. Briggs of the University of Sydney have not been able to locate them for me. Types of species described in S. J. Johnston's papers published in 1913 and 1917 are in the collections of the School of Public Health, Sydney (formerly the School of Tropical Medicine, Townsville, North Queensland), and the Australian Museum, Sydney, respectively. Nicoll's types (1914) were deposited in the former institution. All my early collections of trematodes were handed over to S. J. Johnston for study and formed part of the material described by him in 1917.

I desire to acknowledge assistance received from the Commonwealth Research Grant to The University of Adelaide; from Messrs. G. & F. Jaensch and L. Ellis of Tailm Bend, South Australia, for supplying local cormorants; to Dr. M. J. Mackerras and her father, the late Dr. T. L. Bancroft, for some material from Queensland; to Professor E. A. Briggs for the loan of S. J. Johnston's serial sections of *Echinochasmus tenuicollis* and *Clinostomum australiense*; and to Dr. A. B. Walkom, Director of the Australian Museum, Sydney, for the loan of the type slides of the two species, just referred to, and that of *Dolichosaccus solecarius*.

TREMATODES FROM CORMORANTS AND DARTERS

There are five species of cormorants occurring in Australia, *Phalacrocorax carbo* (*novae-hollandiae*), *P. sulcirostris* (also known as *P. ater*), *P. melanoleucus*, *P. fuscescens* (*leucogaster*; *gouldi*), and *P. varius*, the last-named being restricted to coastal regions. *P. melanoleucus* appears to be by far the most common species occurring along rivers and swamps. Trematodes have been obtained from all these species, as well as from the only Australian species of darter, *Anhinga novae-hollandiae*.

Four species of trematodes have been described from Australian cormorants: (1) *Echinochasmus tenuicollis* S. J. Johnston 1917; (2) *Dolichosaccus solecarius* S. J. Johnston 1917; (3) *Paryphostomum phalacrocoracis* Goss 1940; and (4) *Diplostomum granulosum* Goss 1940; the first two were collected in New South Wales and the remainder from the Swan River, Western Australia. *Clinostomum australiense* S. J. Johnston 1917 was described from a Queensland darter. As a result of the present study, numbers (1) and (3) are placed as synonyms of *Paryphostomum radiatum* (Duj.); (2) has been assigned to a new genus, *Dolichosacculus*; and (4) has been found to be a synonym of *Hysteromorpha triloba* Rud. The occurrence of *Petasiger exaeretus* and *Echinoparyphium phalacrocoracis* in various Australian cormorants is now recorded, and a new species of *Stictodora* is described. Additional species have been collected, but their study is postponed for the present.

Miss Goss (1940) gave a brief account of an immature trematode found in *Phalacrocorax varius* from the Swan River. She considered it to belong probably to the Steringophoridae, and to be a parasite of some fish eaten by the bird. It seems to be a member of the Azygiidae near *Azygia*.

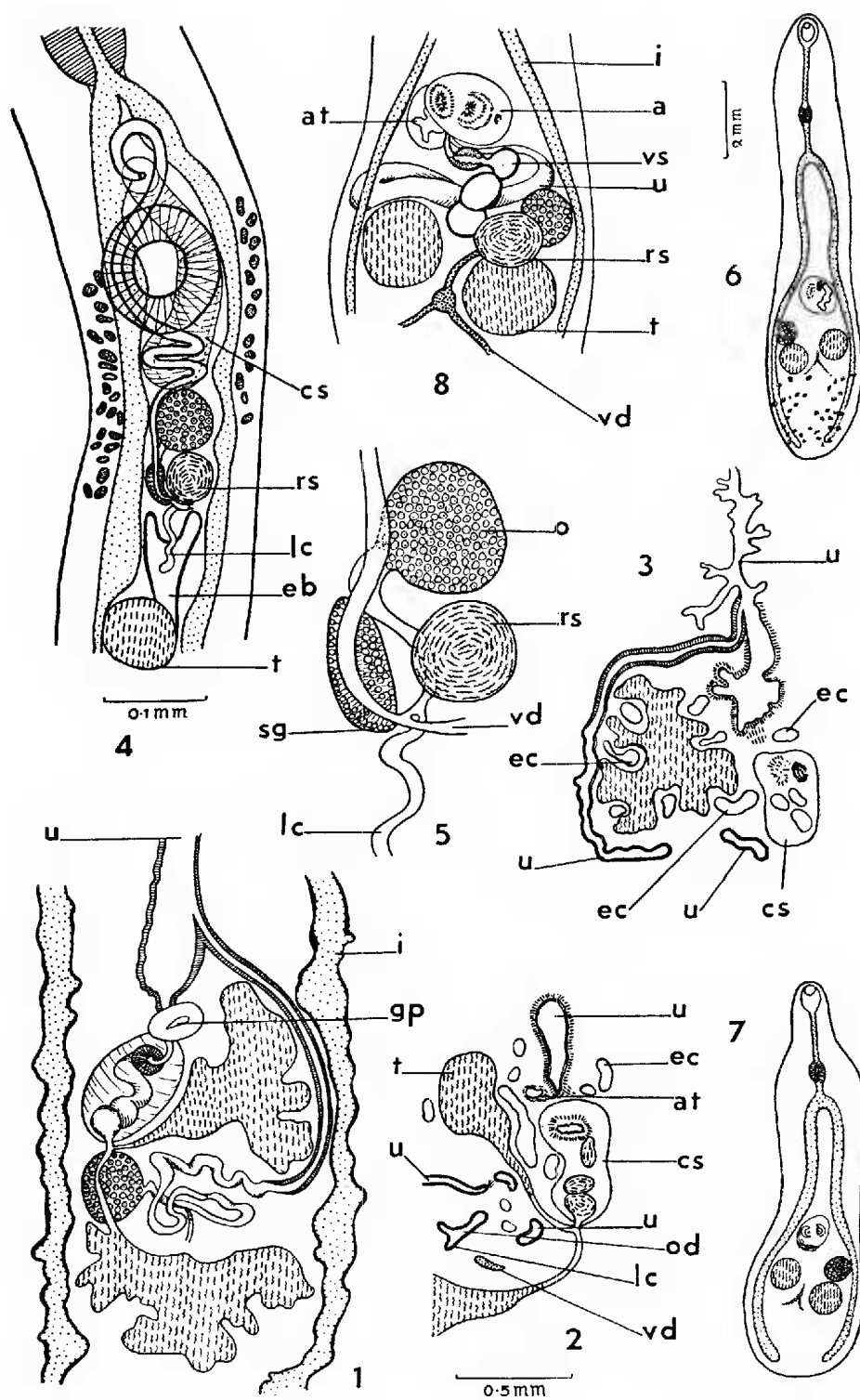
CLINOSTOMUM AUSTRALIENSE S. J. Johnston

(Fig. 1-3)

This species from the oesophagus of a darter, *Plotus* (= *Anhinga*) *novae-hollandiae* from Eidsvold, Burnett River, Queensland, was described and figured by S. J. Johnston (1917, 230-234, fig. 17). An examination of the type slide and

Fig. 1-3 *Clinostomum australiense*: 1, genital system (from S. J. Johnston's type); 2, part of L.H. Sect. to show relation of male ducts; 3, part of L.H. Sect. to show relation of uterus to other organs. Fig. 4-5 *Dolichosacculus solecarius* (from S. J. Johnston's type): 4, reproductive system, ventral view, only anterior vitellaria shown, cirrus sac and acetabulum indicated by dotting; 5, sketch, ventral view of female system. Fig. 6-8 *Stictodora diplacantha*: 6-7, entire worms, various organs omitted; 8, reproductive system, most of uterus omitted, dorsal view. Fig. 1, 2, 3 drawn to scale beside fig. 2; 4 and 8 to scale below 4; 6 and 7 to scale beside 6.

a, acetabulum; at, atrium; cs, cirrus sac; eb, excretory bladder; ec, excretory canal; gp, genital pore; i, intestine; lc, Laurer's canal; o, ovary; od, oviduct; rs, receptaculum seminis; sg, shell gland; t, testis; u, uterus; v, vitellaria; vd, vitelline duct; vs, vesicula seminalis.



serial sections has been made. Length, 11 mm.; maximum breadth (in the region of the gonads), 3.25 mm. The sucker ratio is nearly 1:2.

The excretory system is much more extensive than the figure indicates, and its ramifications extend from the extreme anterior to the extreme posterior end. The main canals and loops are well indicated in the original figure. The bifurcation of the very short terminal portion of the bladder lies very closely adjacent to the ends of the crura. Yamaguti (1933, 67, 69, and fig. 28), in his account of *C. complanatum* from Japanese *Nycticorax*, mentioned that the crura each opened into the excretory bladder. A study of longitudinal horizontal sections of *C. australiense* revealed the presence of a thin membrane separating the termination of each crus from the base of the corresponding arm of the bladder. Canals belonging to the excretory system are abundant in the tissues surrounding the testes, ovary and sex ducts. The caeca have very numerous short irregular diverticula. Gland cells are very abundant in the pre-acetabular region, both intra-caecally and extra-caecally.

The anterior testis is somewhat triangular and lies mainly on the left side. It measures about .66 mm. across its base, and .71 mm. in length. It is almost surrounded by the uterus and cirrus sac. Its vas deferens arises from the inner posterior corner as a thin-walled tube which travels nearly transversely to join the other vas deferens immediately before entering the cirrus sac. The posterior testis is transversely elongate and much lobed and extends almost from one crus to the other. Its maximum breadth is .95 mm. and length .45 mm. Its vas deferens arises from the part of the gland which lies just behind the ovary and travels more or less directly anteriorly to the cirrus sac. The vasa lie ventrally from the ovary. The cirrus sac is elliptical with broadly rounded ends, measures .66 mm. in length by .33 mm. in breadth and lies slightly obliquely on one side of the midline. Its posterior end is almost in contact with the ovary. It contains a wide twisted vesicula seminalis. The cirrus is short and provided with prominent blunt conical spines. There is a well marked genital atrium receiving the uterine aperture anteriorly, while the short male canal from the cirrus sac enters it on the opposite side. The genital pore is median and lies just behind the level of the front border of the anterior testes.

The ovary is almost circular in outline, being about .3 mm. in diameter. It lies directly behind the cirrus sac. The oviduct issues from the mid-region of its inner surface and curves anteriorly and then posteriorly and inwardly. Mehlis' gland is inconspicuous. The main yolk duct enters the oviduct in its vicinity. Laurer's canal is an obvious structure in sections and terminates on the dorsal surface just in front of the level of the anterior border of the posterior testis. Yolk glands are scattered but are restricted, probably because of immaturity of the specimens, to the region in the vicinity of the posterior testis. The uterus is thrown into a number of short curves as it travels forwards from the ootype, making two transverse loops and then a longer third one just behind the anterior testis. It passes around the outer border of the latter on a more ventral level than the crus, and then curves inwards and forwards in front of the testis to enter the median uterus at a very acute angle. Johnston's figure of the uterus in the vicinity of the genital pore is not quite correct. The median uterus or uterine sac is thin-walled with muscular fibres, and has numerous short diverticula in the immature specimens examined. The sac extends forwards to a point distant behind the acetabulum equal to the length of the latter. The posterior portion of the sac is widened and then becomes constricted to join the atrium by means of a narrow muscular uterine canal.

Johnston has pointed out the chief differences between *C. australiense* and *C. marginatum* Rud. which is widely distributed in North and South America in

Ardeiform birds, its metacercaria occurring as cysts in various fresh water fish. The position of the uterus is more like that in *C. attenuatum* than that in *C. marginatum* and *C. complanatum* (Cort 1913). The only other known Australian species is *C. hornum* Nicoll 1914 from Ardeiform birds in North Queensland. The latter is probably a synonym of *C. complanatum*, as Yamaguti (1933, 71) has suggested.

***Dolichosacculus solecarius* (S. J. Johnston 1917) n. gen.**

(Fig. 4-5)

This species is known from a single immature specimen taken from *Phalacrocorax melanoleucus* from Tuggerah, New South Wales. It was described and figured as *Dolichosaccus solecarius* by Johnston, but some details were not referred to adequately. As a result of an examination of the type slide, some additional structures have been seen.

The excretory bladder can be traced forwards as a rather wide tube above the two testes, almost to the region of the shell gland, where it bifurcates to terminate in two short broad arms ending at about the level of the middle of Mehlis' gland. It thus resembles that of *Opisthioglyphe*. The anterior margin of the pharynx bears four prominent rounded lobes. The oesophagus is practically absent.

Just behind the rounded ovary is the thin-walled spherical receptaculum seminis containing a number of ova, its diameter being .42 mm. The oviduct arises postero-laterally from that part of the ovary which lies in front of the shell gland and travels back dorsally above the latter and part of the receptaculum. The shell gland lies laterally from the receptaculum and from the region just behind and between the two arises Laurer's canal which travels posteriorly in a sinuous course to terminate dorsally. A yolk duct can be seen joining the oviduct just before the latter enters the shell gland. The uterus, after leaving the shell gland, becomes thrown into a few short closely-arranged loops between the ovary and the posterior end of the acetabulum and immediately below the vesicula seminalis. It then crosses below the posterior portion of the cirrus sac, travels forward beside the latter, but on the opposite side, and then appears to be thrown into a wide loop below the anterior half of the cirrus sac. It continues forwards and, in front of the sac, it curves back to end at the female pore. The tracing of the course of the uterus has been difficult because of the extreme thinness of its walls, its unstained condition, and the absence of eggs. The cirrus and the terminal portion of the female duct are similar in their relations to those figured by Travassos (1930; fig. 24) for *Dolichosaccus rastellus*.

The systematic position of the species has remained uncertain. S. J. Johnston included it in his genus *Dolichosaccus* with some doubts, stating that it differed from the three known species, all of them from Australian frogs, in its cylindrical form, in the relative sizes of the two suckers, and in the topography of the vitellaria. The latter, in species from amphibians, are not restricted to the zone below and laterally from the crura but are widely distributed and occupy a broad post-ovarial zone; they also extend much further forward than in *D. solecarius* and may reach the level of the pharynx. The genus as originally diagnosed would include *D. solecarius*, except for the distribution of the yolk glands. Though Johnston stated that it was doubtful whether a receptaculum seminis was present in species of the genus (1912, 309), his type, *D. trypherus*, as figured by him (fig. 4), shows the presence of such an organ which he called a "fertilization space," and he actually called the organ a receptaculum seminis in his fig. 5 (*D. trypherus*), fig. 7 (*D. ischyryus*) and fig. 8 (*D. diamesus*). He regarded *Dolichosaccus* as being close to *Opisthioglyphe*. He placed it in the Plagiorchinae (1912); 1917).

Perkins (1928) allocated the genus to the Telorchiniinae. He included it in his key to the subfamily and regarded the species described from Australian frogs as validly included in it and (p. 353) incorporated them in his key. He went on to state that another species placed in the genus, *D. parvula* Johnston (*sic*) 1916, was known only by a single very young specimen (from a bird, *Phalacrocorax*), which had an exceedingly short uterus containing only one large egg and which therefore should probably be removed to the Psilostominae. He did not include it in his key to species of *Dolichosaccus*. Perkins apparently confused S. J. Johnston's specific name, *solecarius*, with Nicoll's *Dolichopera parvula* which is also mentioned in the same paper. Johnston (1917, 220), in his original account, stated definitely that the uterus was short and did not extend back beyond the shell gland and that it contained no eggs. Perkins (1928, 343) thought that *Dolichosaccus* and *Brachysaccus* (both from Australian frogs) were probably not distinct, but an examination of Johnston's figures shows that in the latter the cirrus sac is shorter and lies in front of the acetabulum, Laurer's canal is very much larger, and the uterus is much more extensive, occupying most of the intercaecal space between the ventral sucker and the testes.

Travassos (1930, 2) when dealing with *Opisthioglyphe* and related genera, placed *Brachysaccus* under the former, and showed that Perkins' *Lecithopyge* was a synonym of *Dolichosaccus*. He gave a diagnosis of the last-named and included the presence of a spermatheca as one of the features (1930, 11). He did not include *D. solecarius* in the genus as he considered that its occurrence represented a case of accidental parasitism of the cormorant by a young specimen of a fish trematode near *Podocotyle* (Allocreadiinae), young flukes being more easily able to adapt themselves temporarily in a new host. In this connection it is of interest to mention that Miss Goss (1940) recorded the finding of an immature trematode, regarded as belonging to the Steringophoridae, in *Phalacrocorax varius* from Perth, Western Australia. The specimen was believed (no doubt correctly) to belong to a species infesting fish. Her account and figure suggest a member of the Azygiidae, such as *Azygia* sp., rather than a Steringophorid.

Mehra (1931, 175) allocated both *Dolichosaccus* and *Brachysaccus* to the Telorchiniinae, placing the former (in his diagram) between *Cercorchis* and *Brachysaccus*. In a later paper (1937) he retained *Dolichosaccus* in that subfamily.

From the foregoing statements it will be seen that *D. solecarius* has been variously assigned. The appearance of the specimen suggests a member of the Telorchiniinae, but the position of the uterus resembles that of many Allocreadiids. The form of the excretory bladder allocates the parasite to the Plagiorchioidea, so that membership of the Allocreadiidae can be definitely excluded.

The parasite from *Phalacrocorax* differs especially from typical species of *Dolichosaccus* in the distribution of the yolk glands. These are restricted to the vicinity of the caeca between the level of the ventral sucker and the end of the caeca and located especially laterally from the caeca, but they extend to lie ventrally to the latter, leaving the intercaecal field free from them.

The differences from *Dolichosaccus* may be best expressed by regarding *D. solecarius* as representing a new genus, *Dolichosacculus*, with the following characters: Telorchiniinae; characters as in *Dolichosaccus* except that the body is more or less cylindrical and the vitellaria are restricted to the caecal and extra-caecal regions behind the mid-acetabular level. Type *D. solecarius* (S. J. J.) from *Phalacrocorax melanoleucus*. The genus is close to *Dolichosaccus* and *Opisthioglyphe*.

The systematic relationships of *D. solecarius* suggest that its presence in a cormorant may be accidental and that its true host may be a frog, since all known species of *Dolichosaccus* and *Opisthioglyphe* occur in frogs. It may be mentioned

that the cercaria of a very common trematode, *Paryphostomum radiatum*, widely distributed in Australian cormorants, can infect tadpoles and thus reach its meta-cercaria stage (Johnston and Angel, 1942).

PARYPHOSTOMUM RADIATUM (Duj.) Dietz

Distomum (Echinostoma) radiatum Dujardin 1845.

Paryphostomum radiatum Dietz 1909; 1910; Lühe 1909; Edwards 1927.

Echinochasmus tenuicollis S. J. Johnston 1917; T. H. Johnston 1918.

Paryphostomum testitri-~~folium~~ Gogate 1934.

Paryphostomum phalacrocoracis Goss 1940.

Paryphostomum tenuicollis Johnston and Angel 1942.

Paryphostomum testitri-~~folium~~ Goss 1940, 5-6 (error for *testitri-~~folium~~*).

The first Australian reference to the parasite was that by S. J. Johnston who described it as *Echinochasmus tenuicollis* (1917, 206), the host being *Phalacrocorax melanoleucus* from New South Wales. He stated that the 19 dorsal spines were arranged in an uninterrupted row and varied little in size; the testes were three-lobed; the uterus little coiled; and the vitellaria terminated anteriorly some distance behind the ventral sucker. I identified it (1918, 212) from the same host species from the Thompson River, Western Queensland, and drew attention to the extension of the vitellaria as far forward as the level of the posterior edge of the acetabulum, as well as to the more anterior position of the male and female glands than was indicated in the original figure.

A recent examination of my material indicated that the species did not belong to *Echinochasmus* but to *Paryphostomum*, and it was under the name *P. tenuicollis* that the account of its life history and an extended host list were published by Johnston and Angel (1942). In South Australia it was ascertained that its molluscan hosts were the pond snails, *Amerianna pyramidata*, *A. pectorosa* and *A. tenuistriata*. It is probable that any Australian species of *Amerianna* (*Physa*, *Galinus* and *Isodora* of Australian authors) would be able to serve as the molluscan host. The cyst stage was obtained experimentally in five species of aquarium fish, as well as in the tadpole of *Pseudophryne bibroni*, and was found occurring as natural infections in three species of fish from the Murray swamps at Tailem Bend, South Australia; viz., *Carassius auratus* (golden carp), *Pseudaphritis urvilli* (congolli), and *Tandanus tandanus* (cat fish). The adult stage was recorded from the following species of cormorants in South Australia: *Phalacrocorax carbo*, *P. melanoleucus*, *P. fuscescens*, and *P. sulcirostris* (syn. *P. ater*). The arrangement of the collar spines in a double row was figured and the sizes published.

Miss Goss (1940) described *Paryphostomum phalacrocoracis* from *Phalacrocorax ater* and *P. melanoleucus* from the Swan River, Western Australia, and published a comparative table of various characters and measurements of *P. radiatum* (of Dietz and of Edwards) and *P. testitri-~~folium~~* Gogate.

A comparison of the accounts and figures published by Dietz, Edwards, Gogate and Goss indicates that they were all dealing with the same species, since the differences listed are only minor variations. A study of S. J. Johnston's type, as well as of my own material from Queensland, New South Wales, Victoria and South Australia, has permitted me to synonymize *P. tenuicollis* with *P. radiatum*.

A re-examination of the type specimen of *P. tenuicollis*, which is that figured by S. J. Johnston (fig. 5), shows that it is 2.47 mm. long by .59 mm. in maximum breadth (somewhat compressed) and is immature and that the uterus contains only one egg. The latter is undersized, and has a colourless shell and lies adjacent to the shell gland. The structure of the female complex is essentially like that of *P. radiatum* as described by Edwards. The dorsal collar spines are arranged in

two series, those of the more anterior row being very slightly longer than those of the second row, the sizes being respectively $\cdot 09$ and $\cdot 088$ mm. The testes are trilobed but the anterior shows the presence of a small fourth lobe in front. The other details regarding its anatomy have been published by S. J. Johnston.

I have already stated that in Queensland material the vitellaria extended forwards to the acetabular level, and that the ovary and testes were situated more anteriorly than was indicated by S. J. Johnston. As a result of an examination of a large number of specimens from various Australian localities, it has been ascertained that the length of egg-bearing worms ranges between 2.4 and 5 mm., the maximum breadth being about one-fifth or one-sixth the length. Longer specimens (up to 5.8 mm. long) were collected, but they were relatively narrower ($\cdot 6$ – $\cdot 66$ mm.) and in them the uterus was very long and narrow, extending back for 1.43 mm. behind the end of the acetabulum. Such specimens resemble that figured by Miss Goss (fig. 1). Most of our mature worms resembled closely those figured by Dietz and by Edwards.

Two series of collar spines are usually recognisable, especially mid-dorsally, but the interval between the two is generally slight. The sizes fall within the ranges listed by Miss Goss. The following sizes were observed. Spines of the anterior dorsal series measure about $\cdot 102$ mm. long, those of the second series about $\cdot 092$ – $\cdot 095$ mm., the shoulder spines about $\cdot 107$ mm.; the spine next to the group of corner spines, $\cdot 092$ – $\cdot 097$ mm. (this spine is in series with the posterior dorsal series), the corner spines are unequal in length the ventral inner being about $\cdot 112$, ventral outer $\cdot 105$, upper inner $\cdot 118$, and upper outer $\cdot 136$ mm., all these measurements being taken from heads lying in glycerin in a favourable position for measuring.

In mature worms the centre of the aperture of the acetabulum lies at about the end of the first fourth or fifth of the body length, while the posterior edge of that sucker is situated at about one-third of the body length from the anterior end of small mature specimens and at about two-fifths in the case of large adults.

The post-testicular region varies in relative length according to the age of the worm, and to some degree so also does the length of the preovarian region (measuring from the front of the ovary to the anterior end of the worm). The former lengthens with age and the latter diminishes. In specimens 1.3 mm. long post-testicular region was $\cdot 275$ – $\cdot 33$ mm., ratio of the latter to body length 1:4.4–6, preovarian region $\cdot 75$ – $\cdot 99$, ratio of the latter to body length 1:1.3–1.7; in a worm 2 mm. long these measurements and ratios were $\cdot 42$, 1:4.7, 1:16, 1:1.7; in worms 2.6 to 2.7 mm. long they were $\cdot 53$ – $\cdot 66$, 1:4.5, 1:12–1:13, 1:2.3–3; in a worm 2.9 mm. long they were $\cdot 55$, 1:5.3, 1:37, 1:2; and in a specimen 3.44 mm. in length they were $\cdot 99$, 1:3.5, 1:5, 1:2.3 respectively. All the worms just referred to had not yet reached the egg-bearing stage, though the longer parasites had ovarian eggs in the oviduct and nearly all had sperms in the receptaculum seminis.

In S. J. Johnston's type (which had just entered egg-bearing, the first egg having entered the uterus), the post-testicular region was nearly one-fifth of the body length and the ovary was situated just behind the mid-body.

The longest worm observed which had not yet become egg-bearing was 2.97 mm. long and $\cdot 44$ mm. wide at the acetabulum, but only $\cdot 3$ mm. wide at level of the testes, the post-testicular region being 1:4.5 of the body length. It was probably somewhat macerated. The shortest specimens found with one or more eggs in the uterus were 2.4 mm. and 2.47 mm. long. The former had two eggs, poorly developed vitellaria, a postacetabular region 1.3 mm. long, and its post-testicular zone was 1:3.3 of body length. The other worm which was of the same length of the type specimen had six eggs, a postacetabular length of 1.49 mm., and

a post-testicular zone .58 mm. long 1:4). In mature specimens with abundant eggs in a closely coiled uterus the latter occupies 1:3-3:8 of the body length. Miss Goss' figure indicates that in a very narrow worm 6 mm. long the latter region was 1:3:5 of the body length and that the preovarian length was one-eighth of the total. Dietz's figures show the post-testicular zone to be about 2:5 of body length in a worm 5.2 mm. long and 2:7 in one 6.8 mm. long. The testes are very variable in outline and, as stated by Dietz (1910), possess from three to seven or more lobes. The following indicates the conditions seen by us in the anterior and posterior testes respectively, minor lobulations being indicated after the plus sign: 3 + 1. 3; 3 + 2, 3 + 4; 3, 3; 5, 6 + 3; 4, 4; 4, 7; 4, 6; 3, 6.

The vitellaria extend forwards at least as far as the posterior border of the acetabulum in worms which are mature, but in specimens under 3 mm. in length the follicles usually do not reach more than half-way between the front of the ovary and the end of the acetabulum.

Edwards published an excellent account of the female complex. The receptaculum seminis is a conspicuous thin-walled structure appearing at first sight to be spherical, but if it be followed down ventrally it will be seen that it narrows only slightly to join the oviduct while its opposite side becomes somewhat pear-shaped to form eventually a very narrow ootype passing almost directly ventrally through the relatively large "shell gland," receiving the very narrow vitelline duct before entering. The uterus widens suddenly into a tube lying below the axis of the shell gland and then skirting the ovary or passing below it, travels forwards in a few loops which lie close together when the uterus is full of eggs. On reaching the posterior border of the acetabulum the tube becomes only slightly sinuous. The metraterm is well supplied with sphincter fibres. Laurer's canal arises from the receptaculum as a very narrow, rather thick-walled tube which, after a very short course, terminates on the surface above the region of the shell gland. The folded condition of the large vesicula seminalis is shown in Edwards' figure. The extended cirrus measures .43 mm.

The short oviduct is very wide, and tapers rapidly before passing dorsally to become the receptaculum. The latter commonly contains masses of sperms. The transverse yolk duct skirts very closely the posterior edge of the shell gland. The yolk reservoir is usually conspicuous.

The form of, and space occupied by, the uterus vary with the sexual condition of the worm. When immature, it is only slightly sinuous and is relatively long (its course between the front of the ovary and the posterior edge of the acetabulum cup extending for more than one-fifth of the body length in the type specimen). It becomes more and more markedly coiled and folded when filled with eggs, and its course, as indicated above, may occupy only 1:25-35 of the body length. That part of it which lies below the ovary and shell gland has not been taken into consideration in connection with these measurements. There is thus a relative shortening of the postacetabular region occupied by the uterus, and associated with this alteration are the forward extension of the vitellaria and an increase in the length of the post-testicular zone.

S. J. Johnston reported that eggs measured .084 by .058 mm.; Dietz .084-.088 by .054-.061; Edwards .08-.1 by .05-.064; Johnston and Angel .07-.084 by .058-.063. The longest I have measured was .092 by .063.

Amongst the material studied were numerous immature stages. The smallest obtained from cormorants were excysted metacercariae measuring only .28 mm. long by .1 to .12 mm. in maximum width, with the almost hemispherical acetabulum in the posterior third of the body. The size of the metacercarial stage was not mentioned by Johnston and Angel (1942), but their figure indicates a long narrow form, .32 mm. in length, .07 mm. wide at the acetabulum, the latter being .03 mm. wide, .05 mm. long, and situated at mid-length.

The following measurements in millimetres of a series of specimens ranging from metacercariae to worms which had not yet reached the egg-bearing stage indicate the relative lengthening of the acetabulum, and the post-acetabular region in relation to the increasing length of the parasite: (i) total length; (ii) breadth at acetabulum; (iii) length of acetabulum (*i.e.*, from front edge to posterior end of base; (iv) breadth of acetabulum; (v) distance from front edge of acetabulum to head end (*i.e.*, pre-acetabular length); (vi) distance from posterior end of base of acetabulum to end of worm (*i.e.*, post-acetabular length); (vii) approximate ratio of (v) to (vi); (viii) length from centre of aperture of acetabulum to head end; (ix) length from centre of aperture of acetabulum to end of body; (x) approximate ratio of (viii) to (ix).

	i	ii	iii	iv	v	vi	vii	viii	ix	x
1 ...	·28	·1	·06	·06	·16	·06	8:3	·19	·09	2:1
2 ...	·46	·13	·12	·10	·19	·14	10:7	·24	·23	1:1
3 ...	·51	·17	·13	·11	·24	·13	2:1	·30	·21	3:2
4 ...	·58	·18	·15	·13	·26	·15	5:3	·32	·25	4:3
5 ...	·66	·16	·14	·12	·26	·23	10:9	·32	·33	1:1
6 ...	·87	·27	·25	·20	·32	·30	1:1	·40	·47	5:6
7 ...	·88	·23	·15	·15	·31	·52	3:5	·37	·51	3:4
8 ...	1·25	·42	·32	·28	·36	·57	5:8	·45	·80	1:1·8
9 ...	1·30	—	·33	—	·33	·64	1:2	—	—	—
10 ...	1·32	—	·35	—	·44	·88	1:2	—	—	—
11 ...	1·32	·35	·30	·27	·43	·57	3:4	·54	·80	1:1·5
12 ...	1·80	·40	·38	·32	·60	·80	3:4	·68	1·12	1:1·7
13 ...	1·98	—	·42	—	·55	1·43	1:2·6	—	—	—
14 ...	2·64	·55	·44	·55	·58	1·54	1:2·6	—	—	—
15 ...	2·69	·44	·55	·42	·62	1·54	1:2·5	—	—	—
16 ...	2·91	·53	·55	·42	·55	1·76	1:3·2	—	—	—
17 ...	3·44	·55	·58	·41	·66	2·20	1:3·3	—	—	—

Paryphostomum radiatum is now known to occur in the following Australian localities (including those now recorded) and species of cormorants: *Phalacrocorax melanoleucus*—Brisbane and Longreach, Queensland; Tuggerah, New South Wales; Gippsland, Victoria; Tailern Bend, South Australia; and Perth, Western Australia. *P. sulcirostris*—Burnett River, Queensland; Glenelg River, Victoria; Tailern Bend and Adelaide, South Australia; Perth, Western Australia. *P. carbo novae-hollandiae*—Burnett River, Queensland; Bathurst, New South Wales; Tailern Bend and Hope Valley, South Australia. *P. fuscescens*—Tailern Bend. The only Australian species from which the trematode has not been obtained is *P. varius*, a cormorant restricted to a coastal habitat. It appears probable that *Paryphostomum radiatum* is a parasite associated with swamps and rivers rather than marine environments.

Dietz (1910) recorded it from *P. carbo* from Central Europe, and Edwards (1927) from the same species from Wales. Yamashita (1938, 1085) reported it from *P. carbo hanedae* from Japan. Yamaguti (1939, 143-4) gave a brief account of specimens from the latter host species, as well as from *P. capillatus*, both from Japan. Gogate's *Paryphostomum testitriifolium*, stated to have been taken from a Burmese tree-duck, *Dendrocygna javanica*, agrees so closely with *P. radiatum* that it should be placed in synonymy.

PETASIGER EXAERETUS Dietz

This minute echinostome has been found in *Phalacrocorax carbo* from Tailern Bend, South Australia, and from Bathurst, New South Wales; *P. melanoleucus* and *P. sulcirostris* from Tailern Bend. S. J. Johnston's type slide of *Dolichosaccus*

solecarius from *P. melanoleucus* from Tuggerah, New South Wales, contains a specimen of *Petasisiger exaeretus*.

The dimensions and certain other features differ markedly from those given by Dietz (1910) whose material came from *P. carbo* from Europe, but they agree sufficiently closely with the measurements given by Davies (1934) for specimens from *P. carbo* from Wales. The following account is based on specimens from South Australia.

Length 1.2-1.3 mm., but up to 1.76 mm. in worms with very elongated pre-acetabular region; maximum breadth (at the acetabulum) .31-.38 mm.; width of the head collar .23, and of the neck .17-.18. In a worm 1.3 mm. long and .34 mm. in breadth, the gonads were fully developed but no egg was present; while in another of similar dimensions (1.2 mm. long by .35 mm. in maximum width) there were five eggs. The preacetabular region of the body is covered by abundance of scales. The oral sucker is more or less circular, .04-.06 mm. long by .04-.07 mm. wide; the acetabulum is almost circular in outline, .18-.24 mm. wide by .19-.25 mm. long. The ratio of breadths of the two suckers is 1:3-3.5; and of lengths 1:3-5, usually about 1:3. The distance from the anterior border of the acetabulum to the head end of the worm, *i.e.*, the preacetabular length, is approximately half the body length, the ventral sucker lying wholly in the posterior half. The postacetabular length (*i.e.*, measuring from the hinder border of the acetabulum to the end of the worm) is about one-third of the total length. There are 27 spines including the two corner groups, each with four. The larger pair of corner spines are about 75-77 μ long and the other pair about 60-70 μ , the width being 12-13 μ . The first lateral spine is the smallest and narrowest in the series; it measures 35-40 μ long and may overlap the corner spines. The remaining laterals are 57-65 μ long, the length increasing as they approach the dorsal surface. The dorsal spines are arranged in two series, those of the anterior series being much shorter (36-42 μ long) and narrower (4 μ broad) than those of the second group (45-55 μ by 6-7.5 μ), the shortest and thinnest in the groups being those nearest the mid-dorsal region. All spines are rather pointed, especially the dorsal series.

The prepharynx is about .05 mm. long; the pharynx .076-.08 mm. long by .034-.04 mm. wide; and the oesophagus .27-.3 mm. long. The crura extend almost to the end of the worm.

The testes are tandem, slightly elongate transversely, especially the anterior, the posterior being usually rather narrower and longer than the other. The dimensions are .19-.22 mm. broad by .1-.15 mm. long. The thin-walled cirrus sac lies somewhat obliquely on one side in the region between the crura and the acetabulum, and extends back above or beside the anterior third of the latter. It measures about .14 by .05 mm. and its posterior half is occupied by the folded seminal vesicle. The genital aperture is immediately behind the intestinal bifurcation.

Davies has given a good account and figure of the female complex. The ovary is about .075 mm. in diameter and lies to one side of the midline. The receptaculum is closely associated with the shell gland and is of about the same size but rather less regular in shape. It lies between the ovary and shell gland, and is approximately in the median line. The course of the uterus is similar to that described by Davies, as also is that of the yolk ducts and yolk reservoir. The yolk follicles do not extend forwards much beyond the mid-level of the acetabulum. They may invade the edges of the testicular field to a slight extent. The arrangement is the same as that given by Davies and unlike that described and figured by Dietz. The uterus is very short, forming a loop in the vicinity of the ovary and then travelling forwards, parallel with the cirrus sac. In some specimens the thicker-walled vaginal portion is greatly dilated into a more or less spherical structure several times the size of the cirrus sac and filled with a darkly-staining secre-

tion. Eggs measure $\cdot 055\text{--}\cdot 09$ by $\cdot 055\text{--}\cdot 067$ mm. The maximum number seen in the uterus was nine, but there were usually 1-5.

Petasisger exacretus has been recorded by Dietz from Central Europe and by Davies from Wales, in both cases from *Phalacrocorax carbo*. Yamashita (1938) reported its presence in *P. carbo hanedae* in Japan. Its known range is now extended to include south-eastern Australia.

HYSTEROMORPHA TRILOBA (Rud.)

Distoma trilobum Rud. 1819.

Hemistomum trilobum Dies 1850; Lühe 1909; Krause 1914.

Proalaria triloba La Rue 1926; Ciurea 1930.

Diplostomum trilobum Hughes 1929; Ciurea 1933.

Hysteromorpha triloba Lutz 1931; Dubois 1938; Yamaguti 1939.

Diplostomum granulolum Goss 1940.

The only Australian record of this diplostome was that of Miss Goss (1940, 6-7) who described it as *Diplostomum granulolum* from *Phalacrocorax ater* from Perth, Western Australia. I have obtained it from *P. carbo noxae-hollandiae* from Tailem Bend, South Australia, and Bathurst, New South Wales; *P. melanoleucus* from Tailem Bend, and Glenelg River, Victoria; *P. sulcirostris (ater)* from Tailem Bend; and *P. fuscescens* (Tailem Bend). A comparison of the accounts and figures published by Krause (1914), Lutz (1931), and especially those by Dubois (1938), Ciurea (1930) and Yamaguti (1939), with the Australian material and with Miss Goss' account, indicates that *H. triloba* is a very widely distributed species, now being known from *P. carbo* from Austria and Roumania; *P. pygmaeus* from Roumania; *P. auritus* from Minnesota, U.S.A.; *P. brasiliensis* from Brazil; *P. carbo hanedae* from Japan; and from the four Australian species mentioned above.

Eggs from my material measured $\cdot 085\text{--}\cdot 093$ mm. by $\cdot 060\text{--}\cdot 068$, most of them being $\cdot 087\text{--}\cdot 090$ by $\cdot 063\text{--}\cdot 065$ mm. Yamaguti gave the dimensions as $\cdot 092\text{--}\cdot 105$ by $\cdot 06\text{--}\cdot 069$; Goss $\cdot 086$ by $\cdot 085$, but her figures indicate $\cdot 07\text{--}\cdot 08$ by $\cdot 07\text{--}\cdot 50$ mm.; Dubois $\cdot 097\text{--}\cdot 099$ by $\cdot 052\text{--}\cdot 062$; Ciurea $\cdot 075\text{--}\cdot 099$ by $\cdot 048\text{--}\cdot 075$ mm. Lutz (1931) and Ciurea (1930; 1933) have published information relating to stages in the life history of the species.

ECHINOPARYPHIUM PHALACROCORACIS Yamaguti

This small trematode was described recently by Yamaguti (1939, 142) from the Japanese cormorants, *P. carbo hanedae* and *P. capillatus*. I have collected it from *P. carbo noxae-hollandiae*, *P. sulcirostris* and *P. melanoleucus* from Tailem Bend. Very few specimens were present on the few occasions that the parasite was obtained.

The narrow body measures $1\cdot 6\text{--}2\cdot 1$ mm. by $\cdot 29\text{--}\cdot 22$ mm. in maximum width (at the acetabulum). The head is somewhat pointed, $\cdot 15\text{--}\cdot 17$ mm. wide, not sharply marked off from the neck which at the level of the pharynx measures $\cdot 16$ to $\cdot 2$ mm. There is little variation in width from the region of the genital pore to that of the posterior testis. The oral sucker is nearly spherical, measures $\cdot 06\text{--}\cdot 08$ mm. long by $\cdot 06\text{--}\cdot 07$ mm. wide. The acetabulum is $\cdot 17$ mm. long by $\cdot 16$ mm. wide and lies at the end of the first third and anterior part of the middle third of the body length. The preacetabular length (measuring from the front edge of the organ) is $1\cdot 2\cdot 6\text{--}2\cdot 7$ of body length, and the postacetabular length (measuring from the posterior edge of the base of the organ to the end of the worm) $1\cdot 1\cdot 86\text{--}1\cdot 9$ of body length. The sucker ratio is $1\cdot 2\cdot 3\text{--}2\cdot 6$ for breadths and $1\cdot 2\cdot 1\text{--}2\cdot 8$ for lengths. The distance between the centres of the apertures of the suckers is $\cdot 64\text{--}\cdot 77$ mm., i.e., $1\cdot 2\cdot 5\text{--}2\cdot 6$ of body length. The genital pore lies

about $\cdot 07\text{--}\cdot 14$ mm. in front of the acetabulum and a short distance behind the intestinal bifurcation. There are 27 collar spines, including the two end groups each comprising four. The latter are $57\text{--}63\ \mu$ long by $8\text{--}10\ \mu$ wide. The lateral spines are much shorter but vary in length ($36\text{--}42\ \mu$). The dorsal spines are arranged in two distinct alternating series, those of the anterior row being $25\text{--}29\ \mu$ and those of the second row $36\text{--}38\ \mu$ long.

The narrow prepharynx measures $\cdot 075\text{--}\cdot 09$ mm. long; the pharynx $\cdot 065\text{--}\cdot 07$ mm. long by $\cdot 05$ mm. wide; and the narrow oesophagus $\cdot 30\text{--}\cdot 35$ mm. long. The caeca extend almost to the posterior end.

The two rounded testes are arranged tandem and are of approximately the same size, $\cdot 16\text{--}\cdot 18$ mm. diameter, and lie in the posterior half of the body. The cirrus sac is large, about $\cdot 17\text{--}\cdot 2$ mm. long by $\cdot 11$ mm. wide, somewhat obliquely placed behind the intestinal bifurcation and extending back above the anterior half of the acetabulum. Most of the sac is occupied by the voluminous vesicula seminalis which forms a few short curves. The prostatic region is inconspicuous.

The ovary is $\cdot 05\text{--}\cdot 07$ mm. in diameter and lies on one side of the median line at approximately mid-length of the body. The receptaculum seminis is immediately behind, and slightly inwardly from, the ovary, so that its position is approximately median. Laurer's canal lies above it and the shell gland which is somewhat obliquely placed. The short uterus forms a few loops and contains very few eggs. The latter measure $\cdot 08\text{--}\cdot 09$ by $\cdot 06\text{--}\cdot 065$. Vitellaria extend from the posterior end of the worm almost to the mid-acetabular level, and encroach very little on the testicular field though they occupy most of the post-testicular region. The large yolk reservoir lies adjacent to the front edge of the anterior testis.

Stictodora diplacantha n. sp.

(Fig. 6-8)

Many specimens of this small Heterophyid were obtained from cormorants, *Phalacrocorax varius*, from Port Gawler, South Australia. Length, $\cdot 8\text{--}1\cdot 14$ mm.; maximum breadth, $\cdot 21\text{--}\cdot 29$ mm.; the usual dimensions being $\cdot 99\text{--}1\cdot 05$ by $\cdot 21\text{--}\cdot 4$ mm. The longest worms are relatively the narrowest. Extreme anterior end narrowed; posterior broadly rounded. The breadth is fairly constant in the anterior two-thirds of the body, being about $\cdot 17$ mm., widening from the level of the genital atrium to reach the maximum in the region of the ovary and testes. In some specimens there may be a constriction in the prepharyngeal region, and also a slight waist in front of the atrium. The body is beset with delicate sharp spines, these being especially abundant as far back as the level of the posterior testis in some cases, of the ovary in others, while in others they do not reach the region of the pharynx. The rest of the body bears extremely minute spines, the surface being almost smooth.

The oral sucker is ventral, subterminal, $\cdot 061\text{--}\cdot 065$ mm. long and $\cdot 538$ mm. wide. The prepharynx is relatively long, $\cdot 145\text{--}\cdot 153$ mm. in length; pharynx $\cdot 044\text{--}\cdot 046$ mm. long by $\cdot 029\text{--}\cdot 031$ wide; and the oesophagus $\cdot 047\text{--}\cdot 086$ mm. in length. The crura extend almost to the end of the worm and lie close to the lateral border of the body in the post-atrial region. The distance from the crural bifurcation to the head end of the worm is $1\cdot 3\text{--}3\cdot 2$ of the body length.

The genital atrium, together with the highly modified acetabulum, is a conspicuous structure in cleared specimens. It is often slightly oblique; its measurements are, length $\cdot 065\text{--}\cdot 067$ mm., breadth $\cdot 092\text{--}\cdot 1$ mm. Its front edge is distant from the head end $1\cdot 1\text{--}1\cdot 6\text{--}1\cdot 7$ of the total body length, so that the whole organ lies at the end of the middle third of the body. The acetabular portion contains two well-defined gonotyls, not quite equal in size, one of them (that on the ovarian side of the worm) being more ventrally placed than the other. These gonotyls

are similar in structure, each having about 18 strongly curved, sharply-pointed hooks arranged in two series—a basal row of 12-15 (13-14) smaller hooks and a group of five or six much larger central hooks, 17-21 μ long. The specific name is based on the double gonotyl with its prominent armature. The actual atrium has, when at rest, strongly folded walls and into it open the sex ducts. The genital pore is not quite median, being displaced away from the ovarian side of the worm.

The testes are similar, .077-.09 mm. in diameter, with an entire margin, and situated in the intercaecal region in the posterior third of the body. The anterior testis is at about the same level as the ovary, but on the opposite side. The posterior testis lies behind the ovary but is more medially situated. The thin-walled vesicula seminalis is constricted into three spherical structures, each about .05-.08 mm. in diameter. The most posterior lies more or less median between the ovary and the testes and is below the receptaculum seminis; the other two are situated between it and the atrium. The third portion lies adjacent to, or immediately above, the short thick-walled prostate region of the male duct, which is .048 mm. long by .03 mm. wide and is succeeded by the narrow male canal, about .04 mm. long by .012 mm. wide. The latter enters the posterior or postero-lateral region of the atrium.

The ovary is approximately spherical, .05-.12 mm. in diameter, situated on one side of the median line, and distant from the head end 1:1.4 of the body length, i.e., it lies in the posterior third of the worm. The oviduct arises from its inner surface. The receptaculum seminis is relatively large, its diameter (.07-.1 mm) at times exceeding that of the ovary. It partly overlies the latter and may also extend above part of the posterior testis and even reach the edge of the other testis. Below it is part of the vesicula seminalis. The uterus occupies most of the available space in the region behind the atrium and underlies the crural region (in part), testes, receptaculum, vesicula and even part of the ovary. Its terminal portion is more or less transversely placed in front of the gonads, becoming very narrow as it passes forwards just below the male duct to enter the atrium. The scattered vitelline follicles occupy a very thin zone dorsally and ventrally in the post-testicular region and reach almost to the end of the worm. The two main ducts travel forwards and inwards, one of them lying close behind the posterior testis, the two ducts joining to form the small yolk reservoir, about midway between the two testes and situated behind the receptaculum. The common yolk duct travels forwards to terminate below the latter. Eggs are very numerous, .032-.033 by .015-.017 mm. in size, with a slight narrowing towards the opercular end, and sometimes a minute projection marks the edge of the operculum.

A slide containing the type and several paratypes has been deposited in the South Australian Museum. The species resembles *Stictodora japonica* Yamaguti (1939, 175) more closely than any other yet described, but differs from the Japanese parasite in body proportions, relative lengths of the oesophagus and prepharynx, relative position of the testes, structure of the acetabular region and the position of the latter in relation to the body length. Ciurea (1933, 108) placed the genus in the Galactosominae.

AUSTRALIAN HOSTS AND PARASITES RECORDED IN THIS PAPER

ANHINGA NOVAE-HOLLANDIAE Gould

Clinostomum australiense S. J. Johnston, Burnett River, Qld.

PHALACROCORAX CARBO NOVAE-HOLLANDIAE Stephens

Paryphostomum radiatum (Rud.), Burnett River, Qld.; Bathurst, N.S.W.;

Tailem Bend and Hope Valley, S. Aust.

Echinoparyphium phalacrocoracis Yamaguti, Tailem Bend, S. Aust.

Petasisger exaeretis Dietz, Bathurst, N.S.W.; Tailem Bend, S. Aust.

Hysteromorpha triloba (Rud.), Bathurst, N.S.W.; Tailem Bend, S. Aust.

PHALACROCORAX MELANOLEUCUS Vieillot

Paryphostomum radiatum (Rud.), Brisbane and Longreach, Qld.; Tuggerah, N.S.W.; Gippsland, Vict.; Taillem Bend, S. Aust.; Perth, W. Aust.

Echinoparyphium phalacrocoracis Yam., Taillem Bend, S. Aust.

Petasisger exaerctus Dietz, Tuggerah, N.S.W.; Taillem Bend, S. Aust.

Hysteromorpha triloba (Rud.), Glenelg River, Vict.; Taillem Bend, S. Aust.

Dolichosacculus solecarius (S. J. Johnston), Tuggerah, N.S.W. ...

PHALACROCORAX SULCIROSTRIS Brandt (syn. *P. ater* Lesson)

Paryphostomum radiatum (Rud.), Burnett River, Qld.; Glenelg River, Vict.; Taillem Bend, Adelaide, S. Aust.; Perth, W. Aust.

Echinoparyphium phalacrocoracis Yam., Taillem Bend, S. Aust.

Petasisger exaerctus Dietz, Taillem Bend, S. Aust.

Hysteromorpha triloba (Rud.), Taillem Bend, S. Aust.; Perth, W. Aust.

PHALACROCORAX VARIUS Gmel.

Stictodora diplacantha n. sp., Port Gawler, S. Aust.

PHALACROCORAX FUSCESCENS Vieillot (syn. *P. gouldi* Salv.)

Paryphostomum radiatum (Rud.), Taillem Bend, S. Aust.

Hysteromorpha triloba (Rud.), Taillem Bend, S. Aust.

MELEAGRIS GALLOPAVO Linn. (Turkey)

Echinoparyphium recurvatum (Linst.), Melbourne, Vict.

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A NEW MELOMYS FROM QUEENSLAND WITH NOTICE OF TWO OTHER QUEENSLAND RATS

By H. H. FINLAYSON

Summary

Of the three rats from central coastal Queensland dealt with herein, two belong to species which, though known, have not been figured. An opportunity is taken, therefore, of making good that deficiency so far as the material permits and of amplifying the description of one of them. The third proves to be an undescribed form which may be known as

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[Read 8 October 1942]

PLATES VIII AND IX

Of the three rats from central coastal Queensland dealt with herein, two belong to species which, though known, have not been figured. An opportunity is taken, therefore, of making good that deficiency so far as the material permits and of amplifying the description of one of them. The third proves to be an undescribed form which may be known as

***Melomys callopes* sp. nov.**

A small species with very long tail and ear. Nearest to Lonnberg's *littoralis* located 500 miles further north, but differing in its more sombre trizonal colour; in a greyish-white instead of buffy belly; in a more complex pelage with multi-banded fur; and in the larger skull with longer anterior palatine foramina.

The following description is based upon a single specimen, originally in alcohol; an adult female taken about 30 miles south-west of Duaringa in the Rockhampton district. The animal was pregnant with two early embryos in the right horn of the uterus only; stomach contents—granular multi-coloured vegetable matter without identifiable fragments.

External Characters.

Form moderate, limbs rather stout. Head broad with a comparatively short blunt muzzle; well developed though sloping upper lip and prominent mentum. Mystacial vibrissae profuse but attenuated; the longest 43 mm.; black with the extreme tip white. Eye small. Ear large and broad; its substance white at the base of conch and most of the pinna dark lead colour.

Manus large and stout; length from base of carpal pad to tip of apical pad 11 mm.; breadth at base of digits 2-5, 5 mm.; length of third digit, 4.5 mm.; lower side of digits naked and strongly ridged, claws short reaching but slightly beyond apical pads in a palmar view. Pads large and prominent; carpals subequal; the outer descending below the inner but beginning at a lower level proximally; first and second interdigitals broadly pyriform; third bell-shaped and with a distinct postero-external satellite. Outer carpal = inner carpal > first interdigital > third > second.

Pes very broad interdigitally, but tapering rapidly and evenly to the heel where there is considerable lateral infringement of hair; length, 25 mm.; breadth at base of digits 1-5, 6 mm.; third digit, 6 mm. Digits and sole quite naked; former well grooved, claws projecting well beyond apical pads. Plantar pads very large, high, and prominent; beautifully sculptured with unusually broad and crisp outlines. Inner metatarsal much elongated, 4.5 mm., but nearly straight and its surface weakly striate transversely. Outer metatarsal small, round. First interdigital large reniform and with a small semi-detached satellite postero-externally; second and third pyriform and subequal; fourth reniform with its posterior extremity tapered and a distinct postero-external satellite. Inner metatarsal > first interdigital = fourth > second = third > outer metatarsal.

Tail long, very slender and nearly nude with the scales everywhere prominent; mid-dorsally there are 15 scales per centimeter and three hairs per scale.

Mammae prominent; posterior 4 mm. from base of clitoris; anterior 6.5 mm. from posterior.

Pelage

From a skin made up from alcohol after a few weeks' immersion only and with the colouration apparently unchanged, short, fine and moderately soft; dense and difficult to part. Mid-dorsal length of the main pile ca. 8 mm. with a sparse overlay of a longer pile reaching 11 mm. The main pile is not homogeneous but consists of two types of hairs; type one, which are stouter, are blackish plumbeous for the basal quarter of the shaft, followed by a band of Ridgway's clay colour, topped by an attenuated blackish tip; type two, which are more slender and slightly longer, are blackish plumbeous for their basal three-quarters, followed by a greyish-white (Tilleul Buff) terminal band which is carried above the clay zone of the first type and mingles with the blackish points of the latter. The sequence of colour zones from the base up is therefore plumbeous, clay, blackish, greyish-white and again blackish, the latter being contributed by the tips of type one and by the blackish "guard" hairs, which, however, are scarcely coarser than the former and which are white-tipped on the rump.

The resulting external mid-dorsal colour viewed at a little distance is a sombre greyish-brown, near Ridgway's Mummy Brown, with a slight ashy grizzling. On the shoulders and rump the colour is colder (about Mouse Grey), the belt of warmer colour separating these areas, extending as a distinct saddle-shaped marking down to the edges of the belly.

Sides clearer and more buffy, forming at the junction with the belly a sharply contrasted lateral band of Ochraceous Buff extending from the angle of jaw to femoral area.

Ventrum basally, a paler grey than on the dorsum, externally nearly white, but the basal grey everywhere emergent except for a large gular and smaller inguinal area which are creamy white to base. Head like the midback. Upper lip whitish; cheeks buffy like the transition areas of the sides. Ears internally nearly nude with a sprinkling of brownish hairs; externally well haired and almost black with a sprinkling of silver-grey on the posterior margin; the ear as a whole much darker than and well contrasted with the head and back. Limbs externally like the sides, internally grey-white like the belly; dorsum of carpus and manus sparsely haired white, an indistinct greyish marking extending down the outer margin of the metacarpus; dorsum of pes white, faintly tinged with grey and without markings.

Integument of tail about Fuscous of Ridgway above, paler beneath; hairs blackish-brown above and darker than scales; below greyish-brown and paler than the scales. The tail as a whole is darker above than below, but is not strongly bicolor.

Skull

General form broad and stout, but not with dense ossification. Muzzle region short, broad and deep. Nasals tapering strongly but evenly to the frontals, their lateral margins straight or nearly so; the naso-frontal suture narrow but not pointed and with emargination in midline. Anterior root of zygoma thrown boldly outwards almost at a right angle to the long axis of the skull; general zygomatic outline squarish but with the angles softened; the anterior zygomatic width almost equal to the posterior. Anteorbital fossa feebly developed. Interorbital region broad and with smoothly rounded edges. Lacrymals small. Braincase large, moderately elongated in shape, smooth and unridged, with a long interparietal suture. Interparietal long, narrow, spanning the braincase. In side view the skull is unusually deep from above downwards throughout its length, especially in the muzzle region. Free edge of zygomatic plate nearly vertical;

slightly convex at upper end, very slightly concave at lower. Anterior palatine foramina longer than in other species of similar size, reaching beyond the anterior margin of M^1 . Posterior margin of palate with a well-developed spur. Mesopterygoid fossa very wide anteriorly. Parapterygoid fossa deep and with well-defined boundaries. Bullae small.

Incisors and incisive angle moderate; molar rows parallel; the molar crowns simple without supplementary cingular cusps and with the laminae normally arched and discrete. Lower molars with distinct supplementary posterior cusps. Coronoid process of mandible reduced.

Flesh dimensions (in alcohol)—Head and body, 120; tail, 144; pes, 25; ear, 18.

Skull Dimensions—Greatest length, 31.5; basal length, 26.6; zygomatic breadth, 15.5; braincase breadth, 14.4; interorbital breadth, 4.7; nasals length, 11.0; nasals greatest breadth, 3.7; palatal length, 16.8; palatilar length, 14.4; ant. pal. foramina length, 6.1, *ibid* breadth, 2.1; bullae, 4.7; upper molar series, 6.0; molar wear moderate on all laminae.

Type and Habitat as given above.

Structural figures of the nine Australian species of *Melomys* previously described are lacking⁽¹⁾, and existing descriptions alone are frequently inadequate for a proper conception of relationship. Although the present form is closest to *littoralis*, it clearly cannot be merged with that species as described. It may be noted that the habitat, 80 miles from the sea and in an area of comparatively dry and temperate climate, is less coastal than that of the small, more northerly, tropical forms. As the type is in good preservation, an extended description and figures of manus, pes, skull and molars are provided.

PSEUDOMYS (LEGGADINA) PATRIUS Thomas and Dollman 1908

A specimen of this comparatively rare form is available from Cooti Uti, about 100 miles north of Rockhampton, where it was collected on the sea coast by Mr. R. Vallis. The locality is about midway between that of the type and the southerly record near Gladstone given by Troughton in 1936.

In dimensions and all structural characters which can be tested it is in good agreement with the type, but the colouration of the skin made up from alcohol is richer—the dorsum being near Ridgway's Hazel and therefore much brighter than the pale Wood Brown of the original description. How much of this difference is due to alteration in the alcohol it is now impossible to say, but it is noteworthy that the collector spoke of it when taken as a "red-sided mouse." The distribution of colour on appendages and body is exactly as in type.

The specimen was, unfortunately, not sexed before skinning and was too shrunk for an accurate account of its plastic parts to be drawn up. The skull, however, adult with worn molars, is nearly perfect and gives the following dimensions: greatest length, 22.8; zygomatic breadth, 11.4; braincase breadth, 11.1; interorbital breadth, 3.5; nasals greatest length, 8.2; ditto greatest breadth, 2.1; palatal length, 12.0; palatilar length, 10.6; ant. pal. foramina length, 4.3; ditto breadth, 1.5; bulla, 4.0; upper molar series, 4.1.

In dorsal aspect it is very close to the skulls of *hermannsburgensis*, falling between the two phases figured by me (Trans. Roy. Soc. S. Aust., 65, pl. xi, fig. A-B (1941)), but differs in the nasals which are longer and narrower and taper more rapidly. In palatal aspect, too, the mesopterygoid fossa is wider and more open throughout its length and the bullae are smaller in all dimensions. In the dentition the incisors are broader from side to side though of equal depth and

⁽¹⁾ Excellent figures of three extra Australian species have recently been published by Tate: Bull. American Mus. Nat. Hist., 72, 594 (1936).

angle. The molar row is longer and all its members heavier than in the Central animal. The anterior cingular cusp on M^1 is small but distinct and is more apical than in any *hermannburgensis* skull reviewed (*loc. cit.*).

RATTUS CULMORUM cf. *CULMORUM* Thomas 1908

A well preserved example of this rat is in hand from the same locality as the *Melomys* species described above. It is an adult male with worn molars and is in moderately close agreement (in the characters conventionally defined) with the typical race as given by Thomas, though in one or two items it shows an approach to the New South Wales race *vallesius*. The above-mentioned locality is 300 miles south of that of the typical race and about 600 miles north of that of *vallesius*.

External Characters

Stout, short-limbed, medium-tailed. Head large and heavy; both deep and wide and with a short muzzle. Mystacial vibrissae well developed, to 45 mm., the shorter members black with white tip, but the longest entirely white. Eye medium. Ears comparatively short and broad; the conch and central pinna nearly white in substance; margins and upper pinna pigmented to a pale slate only; hairing medium.

Manus—Weak and narrow; length from base of lower carpal to apical pad of mid digit, 11.5 mm.; breadth at base of digits 2-5, 4.5 mm.; middle digit, 4.5 mm. Palm and digits quite nude and pale yellowish-white throughout; nails of medium length, stout and blunt; well fringed. Pads small but well raised and with sharp outlines. Carpals much larger than interdigitals; the outer rather larger, both in length and area, than the inner but the disproportion slight; base of the inner carpal profusely haired from the carpus. Interdigitals subequal in area, one and three bell-shaped or irregularly oval, two broadly oval; three with a small semi-detached satellite at its postero-external corner. Outer carpal > inner carpal > first interdigital = second = third.

Pes—Length, 27 mm.; breadth at base of digits, 1-5, 6 mm.; third digit, 5.5 mm. Sole and digits pale like manus; under-surface of toes and sole nude; the former moderately grooved and the latter very smooth; nails well developed, and moderately fringed. Pads small and weak, except the inner metatarsal which is long (4 mm.), straight and narrow, club-shaped and tapering posteriorly; outer metatarsal very small, oval and barely 1 mm. posterior to the fourth interdigital; first interdigital roughly inverted bell shape and with a large low level heel of similar shape postero-external to it; second interdigital pyriform; third very different from second, broader, almost triangular or heart-shaped; fourth bell-shaped and larger than the first and with a smaller, more distinct heel. In area inner metatarsal > second interdigital = third = fourth > first > outer metatarsal.

Tail shorter than head and body (88%) and rather slender; pale in substance and with the scales showing strongly on all surfaces; mid-dorsally 10 scales per cm.; hairing sparse; pale brown above, lighter below, but not strongly bicolor. Testes large and scrotal; scrotum pigmented on posterior lobes only.

Pelage

Apparently longer (15 mm. mid-dorsally) and perhaps denser and softer than in the typical race, but the colouration quite as given by Thomas.

Flesh Dimensions (in alcohol)

Head and body, 147; tail, 123; pes, 27; ear, 18; rhinarium to eye, 18; eye to ear, 13.

The Skull

Greatest length, 36.0; basal length, 33; zygomatic breadth, 20.1; braincase breadth, 15.9; interorbital breadth, 5.0; nasals length, 12.9; nasals breadth, 3.5;

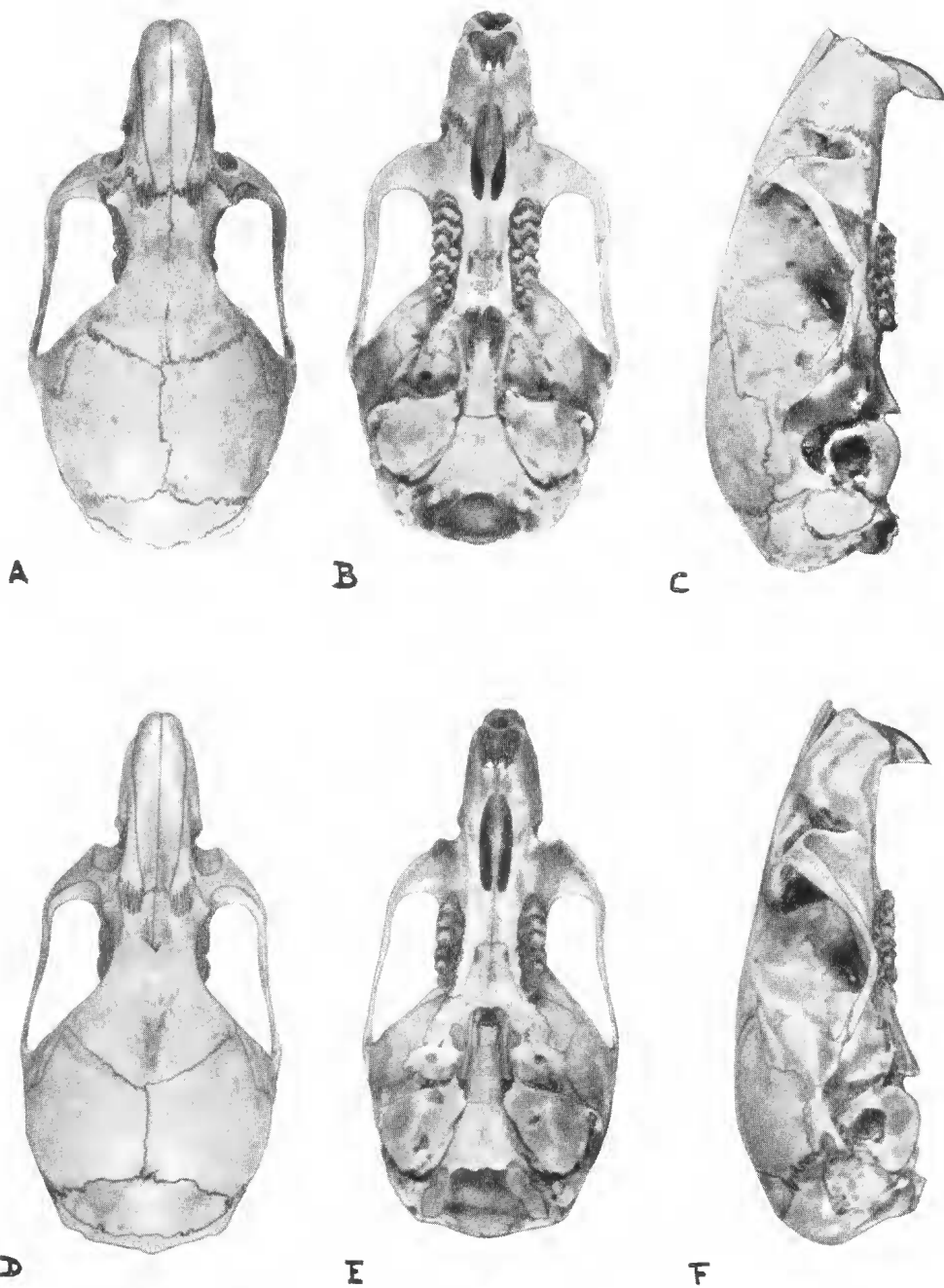


Photo by H. H. Finlayson

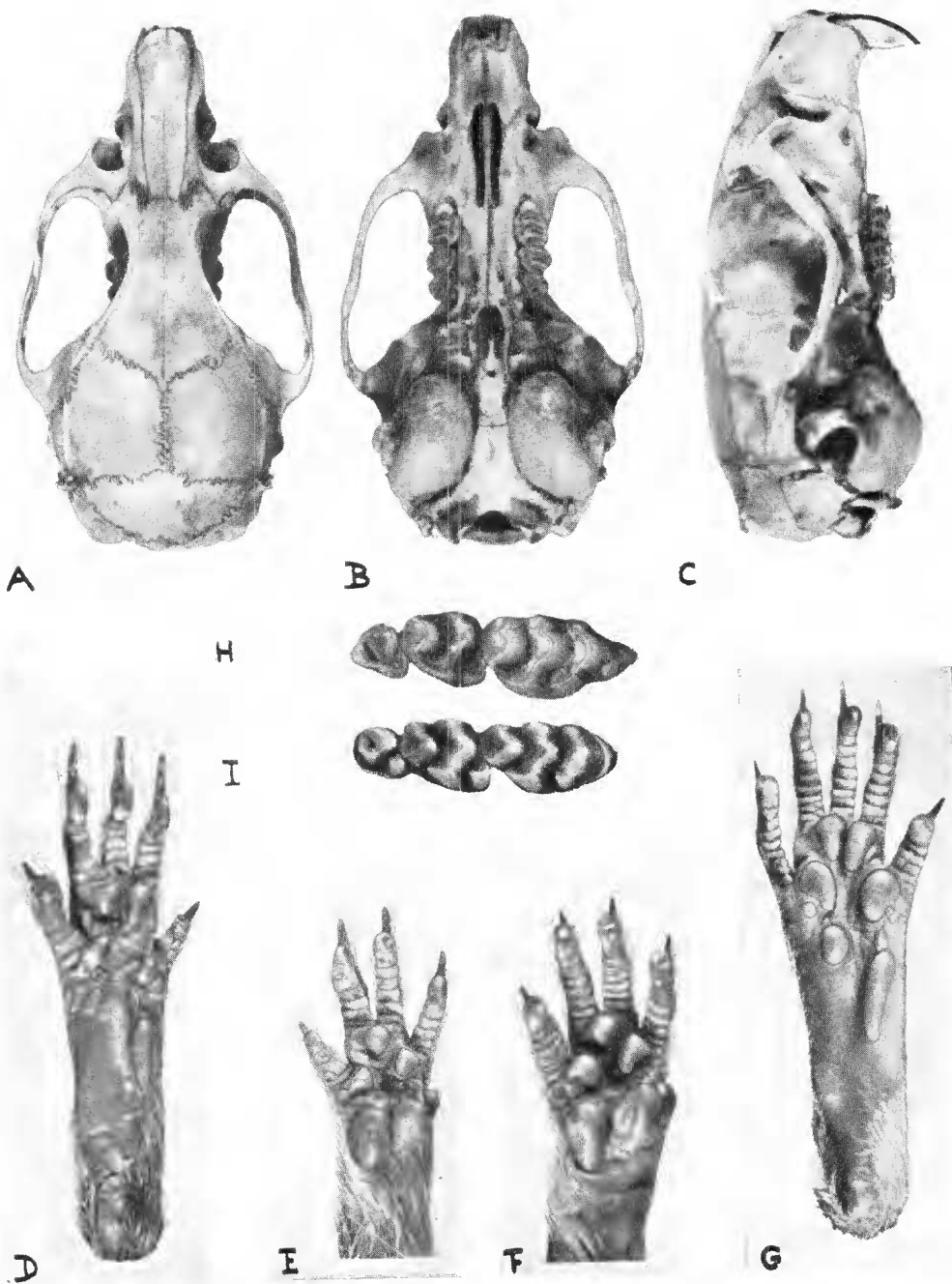


Photo by H. H. Finlayson

palatal length, 19.5; ant. pal. foramina length 7.6; ditto breadth, 2.1; bulla, 8.8; upper molar series (crowns), 7.0.

Impressed by the striking agreements, both structural and metrical, existing between the above *culmorum* skull and that of the animal obtained by the Horn Expedition in Central Australia, described by Waite as *Rattus greyi* and later renamed *Rattus tunneyi dispar* by Brazenor, I have been led to re-examine two of the skulls upon which Waite based his account. These show appreciable discrepancies with his figure which tend to obscure the likeness to *culmorum*. In particular, the beading of the temporal ridges in their posterior course is much exaggerated, the interorbital region is too wide and the bullae much too globular. The molars, however, represent accurately the condition in the younger of the two skulls (spec. B) and indicate a complete absence of the several supplementary cusps described for the typical *tunneyi* by Thomas; they are also absent from Brazenor's figures of *dispar*. Waite's molar dimension is evidently taken from the root at alveolar level, which considerably exceeds the crown measurement.

Careful re-measurement of the two skulls, specimen B a sub-adult male with unworn molars, and the much older female from Tennant's Creek obtained after the Horn Expedition, gives the following values respectively:

Greatest length 34.2, 37 ca.; basal length 30.6, —; zygomatic breadth (posterior) 19.0, 20.5; braincase breadth 15.0, 15.9; palatal length 18.5, 19.7; ant. palatine foramina 7.9×1.7 , 7.7×2.1 ; bullae 7.8, —; upper molar row 6.5, 6.6.

I am unable to check external characters with material, but Waite's dimensions (which exceed Brazenor's type considerably) show no great disparity with *culmorum* varieties, and the pelage characters of the presence of spines and white-based belly fur appear to be the only remaining distinction from that group of rats.

On the whole, there seems as much propriety in treating *dispar* as a race of *culmorum* as of *tunneyi*, and the point is not without interest in its bearing on the derivation of the Central fauna.

The assistance of three correspondents, Mrs. Charles Barnard, Mr. A. Dettrick and Mr. R. Vallis, in forwarding specimens is gratefully acknowledged.

EXPLANATION OF PLATES

PLATE VIII

- A, B, C: Dorsal, palatal, and lateral views of skull of adult ♀ of **Melomys callopes** sp. nov. from Duaringa district, Queensland. (x 2.2 ca.)
 D, E, F: Dorsal, palatal, and lateral views of skull of an adult unsexed example of *Pseudomys (Leggadina) patrius* Thomas and Dollman from Cooti Uti, 100 miles north of Rockhampton, Queensland. (x 3.2 ca.)

PLATE IX

- A, B, C: Dorsal, palatal and lateral views of skull of an adult ♂ of *Rattus culmorum* cf. *culmorum* Thomas from Duaringa district, Queensland. (x 1.9 ca.)
 D, E: Right pes and manus of same. (x 2.5 and 3.0 respectively.)
 F, G: Right pes and manus of **Melomys callopes** sp. nov. (x 2.8 and 3.3 ca. respectively.)
 H: Right upper molars of *Pseudomys (Leggadina) patrius* Thomas and Dollman. (x 9 ca.)
 I: Right upper molars of **Melomys callopes** sp. nov. (x 5.6 ca.)

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA NO. 41

By J. M. BLACK, A.L.S.

Summary

The following species are described in English in the revised Part 1 of the author's "Flora of South Australia."

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No. 41

By J. M. BLACK, A.L.S.

[Presented 8 October 1942]

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GRAMINEAE

Poa humifusa, nov. sp. Glabra, perennis, longe stolonifera; folia conferta; laminae setaceae, flaccidae, saepe curvatae, 2-8 cm. longae, vaginis arctis multo longiores; ligula ovata, brevissima, glabra; crista foliorum cum caule capillari longiore ex quoque nodo stolonum graciliuni orta; panícula parva terminalis, 1-1½ cm. longa, ramis duobus brevibus, utrisque 1-3 spiculas gerentibus; spiculae 3-4 florum, 3-4 mm. longae; prima gluma 2 mm. longa, subtrinervis, secunda 2½ mm. longa, 3-nervis; glumae florum obtusae, fere 3 mm. longae, 5-nerves, demum divergentes, dorso et nervis exterioribus lanatae; palea carinis ciliata, glumae florum aequilonga.

Scrub at Keith and near Mount Gambier, Nov. 1917, *J. M. B.*

Poa halmaturina, nov. sp. Perennis, parva, rigida, glabra, rhizomate repente; folia pleraque in cristibus basilaribus; laminae filiformes, fere pungentes, curvatae, 2-3 cm. longae, vaginis laxiusculis longiores; ligula minuta, truncata; caules erecti, filiformes, 5-10 cm. longi; panícula spiciformis, 1-3 cm. longa, ramis 1-3, erectis, alternis, 1-3-spiculatis; spiculae subsessiles, 2-3-florum, 4-5 mm. longae; glumae florum subacutae, 3½ mm. longae, 5-nerves, parte inferiore et basi lanatae; palea aequilonga, nervis ciliata.

Rocky River, Kangaroo Island, "In burnt consolidated dunes," Dec. 1940, *J. B. Cleland* (on Tate Society Expedition).

LILIACEAE

Lomandra densiflora, nov. sp. Folia rigida, canaliculata vel planiuscula, 20-40 cm. longa, 1½-6 mm. lata, vaginis in capillamenta brunnea fissis; flores masculi patentes, plerique singuli sed in ramis erectis paniculae brevissimae (3-4 cm. longae) dense conglomerati; paniculae rhachis ramique angulares, omnino laeves; caulis perbrevis, latiusculus, plus minusve planus, quasi inter vaginas obtectus; perianthium tenue, segmentis liberis patentibus, exterioribus lineari-lanceolatis, acuminatis, subhyalinis, 3 mm. longis, segmentis interioribus fere ovatis, 2½ mm. longis, viridibus; antherae albae; ovarii rudimentum adest; bractea linearis hyalina, pedicellum circa 1 mm. longum aequans; flores feminei singuli sed approximati, patentes vel nutantes, in paniculam angustam 2-3 cm. longam dispositi, pedicello 2-4 mm. longo, cum bractea lineari hyalina duplo longiore; perianthium campanulatum, basi umbilicatum, 4 mm. longum, segmentis erectis, acutis, subrigidis, apice patentibus; capsula fere matura ovoidea, 6 mm. longa.

Mount Lofty Range and southern districts. Spring and summer. *J. B. Cleland and others.*

Lomandra fibrata, nov. sp. Folio filiformia, debilia, 20-50 cm. longa, ½-1 mm. lata, minute scabra, vaginis in capillamenta numerosa fissis; flores masculi erecti, subsessiles vel brevissime pedicellati, in paniculam spiciformem, paucifloram, 2-3 cm. longam dispositi, ramis basilaribus brevibus unifloris; rhachis

laevis; caulis inter vaginas obtectus; bractea linearis hyalina florem subaequans; perianthium 3-3½ mm. longum, viride, segmentis liberis, exterioribus acuminatis apice incurvis, interioribus paulo brevioribus, ovatis, flavis; flores feminei subsessiles, erecti, campanulati; spica pauciflora, 2-2½ cm. longa, interdum cum paucis ramis basilaribus 1-2 floris; perianthium femineum 3-4 mm. longum, segmentis omnibus acutis; capsula matura nondum visa.

Mount Lofty Range; Mount Remarkable. Nov. *J. B. Cleland*.

Near *L. sororia*, F. v. M., but the latter has a longer, more branched panicle and the outer segments of the flower are shorter than the inner and without the long tips of *L. fibrata*.

Both these species have (like *L. caespitosa* Benth., Ewart) very short spikes, racemes or panicles, sometimes almost concealed among the dense erect bases of the leaves. The long very slender leaves of *L. fibrata*, distinctly scabrous to the touch although the marginal hairs are minute, are characteristic of that species. The thin crowded flowers, spreading horizontally, in the male panicle of *L. densiflora*, and the angular rhachis and rather broad flattish stem below the panicle, distinguish that species from its associates.

POLYGONACEAE

In October 1941 the Pink Dock (*Rumex roseus*, L.) was found to have established itself near Blinman, in the Flinders Range, during the previous two or three years. In September 1942 it was reported to have extended its range and to be occupying a considerable area. Like those other adventives, Salvation Jane (*Echium plantagineum*) and Soursob (*Oxalis cernua*), it is a handsome feature in the landscape, but it has the additional advantage of being nutritious. Experience has shown that sheep like the succulent foliage, and the residents regard it as a useful immigrant. Pink Dock has been cultivated, to a moderate extent, in gardens near Adelaide, where its ripe fruits have a handsome aspect in mass.

AUSTRALIAN ACANTHOCEPHALA NO. 3

By T. HARVEY JOHNSTON and EFFIE W. BEST, University of Adelaide

Summary

The present paper deals with species of *Corynosoma* obtained from bird and mammalian hosts from South Australian waters. Types of the new species, as well as representatives of the others referred to in this report, have been deposited in the South Australian Museum. We desire to acknowledge our indebtedness to the Director of the latter institution for material from *Delphinus delphis*; and also to the Commonwealth Research Grant to the University of Adelaide for financial assistance.